POWER PLANT ENGINEERING

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

OUTDOOR POWER PLANTS

New Diesel Unit for Hudson, Mass. • Report of Midwest Power Conference

Interrupting Capacity of Industrial Switchgear • Maintenance on Schedule

New Western Hydro Plant • Circulation This Issue — 20,300

MAY 1943

Why they cal
Typical group of strainers tagged and ready to go to the shipping room. All of these are Twin Strainers. Some are for oil lines, and some (shown in background) are large units for water service. In the immediate foreground, a high-pressure strainer as used on fuel oil discharge, and at its right, a strainer for low-pressure suction service. Notice the chain drive which operates both gate valves simultaneously, shifting the flow from one cylinder to the other.
ELLIOT

ELLIOTT

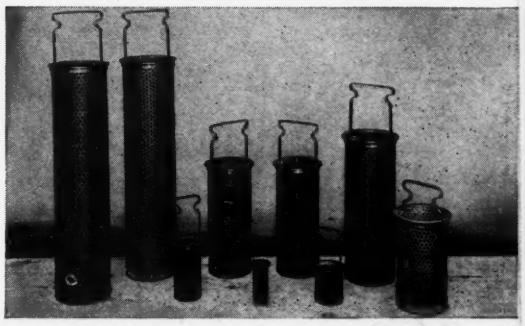
STRAINER HEADQUARTERS"

You might think that the business of straining liquids is small-time stuff. You would be wrong.

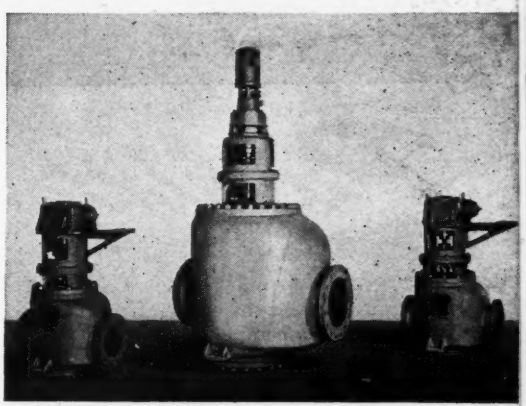
Carload after carload of Elliott strainers are getting into this war. They're going aboard tankers, warships, cargo vessels—straining oil and water. They're going into process plants getting out war materials in the making of which clear liquids are essential. And they're going into the power plants that keep the wheels of production turning.

The mere volume of straining units leaving the Elliott plant is impressive, and alone justifies the term "Strainer Headquarters." But behind that are many years during which Elliott has specialized in these trouble-saving units, designing and developing new types, and advising as to their application, meeting all kinds of unusual problems, straining everything from cold molasses to alcohol. This broad experience is yours to command. Bring your straining problem to "Strainer Headquarters."

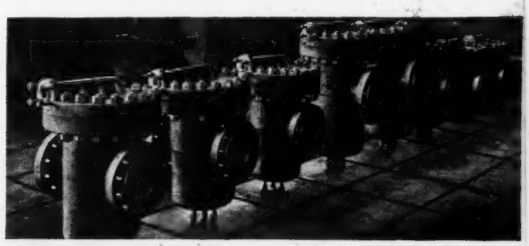
Elliott strainers come in three general types—Single Strainers, where temporary shutdown for cleaning is permissible . . . Twin Strainers, in which the alternate cylinder takes the load while one is being cleaned . . . and Self-Cleaning Strainers which as the name implies, clear themselves without attention, for non-stop service. For details on any of these, write us.



STRAINER BASKETS for any service or liquid. Above are a few of those available, showing the variety of meshes.



SELF-CLEANING STRAINERS, small and large. Driven by motor, which can be mounted vertically or horizontally. Used principally in clearing water of volumes of dirt or other foreign matter.



DESUPERHEATERS TOO — ranking with strainers as an Elliott specialty. They remove the superheat from steam where required. In oil tankers, for instance, steam for main propulsion equipment is heated above the flash point of some petroleum products. Elliott desuperheaters reduce this temperature, insuring safety. Widely used in power plants and in process work.

Army-Navy "E" pennant awarded to both Jeannette and Ridgway plants of Elliott Company.

OMPANY

essories Department, **JEANNETTE, PA.**

RICT OFFICES IN PRINCIPAL CITIES

Pushing A BATTLESHIP AROUND

SWINGING the giant 35,000-ton French battleship Richelieu through busy harbor traffic and warping her into position at her berth is a workaday job for sturdy, pugnacious tugs . . . many of them, Diesel-powered.

To make certain of sustained, full-output from their Diesel engines, operators, afloat and ashore, lubricate them with *Texaco Ursa Oil.*

Texaco Algol or *Ursa Oils* keep Diesel engines *clean,* free from harmful gum, sludge and carbon deposits. Their use assures long life of bearings and liners, free rings, compression-tight piston seal, full power, and *fuel economy.*

Because of Diesel operators' success with it –

More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

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The Texas Company, 135 East 42nd Street, New York, N. Y.

THEY PREFER TEXACO

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

★ More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.

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For All Diesel Engines

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Testing in the Shop that is TIME SAVING In the Field

Piping that is pre-fabricated in any of the Midwest shops is carefully inspected and subjected to the most searching tests . . . . tests for which it was necessary to design and build considerable special equipment. This is representative of the care given every detail of Midwest Pre-fabricated Piping.

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FRONT LINES

CONSERVATION OF FUEL OIL must be practiced by the biggest public utility power plants as well as by the home owner who has to struggle with the problems of heating a five-room house. Philadelphia Electric Co. has reported in its house organ, Current News, that it is doing its part in the program and has reduced its use of fuel oil in several ways. The most important saving has been made by careful scheduling of the combined generating capacity of the large interconnected group of which the company is a part. The hydro facilities at Conowingo, as well as all coal-fired generating capacity, are loaded to maximum before oil-fired capacity is put into use. The only oil-burning station of the company is the Schuylkill Station and this is not operated except in extreme emergency. During the past seven months, there was only one occasion when the Schuylkill boilers had to be operated. The fuel oil consumption at that time was only 900 gal. This compares with the use of approximately 4,200,000 gal. during the corresponding period last year, some of which was burned to save coal when the coal mines suspended operation. Another important saving has been made in the amount of fuel oil required to light off large pulverized-coal-fired boilers. This has been reduced by changing the lighting-off procedure. The reduction amounts to approximately 1000 gal. or 50 per cent of that previously required for each lighting off operation.

LAWN MOWERS an important war product? Well, there they are right near the head of the list of manufacturers allowed preference rating AA-2X for maintenance, repair and operating supplies. How on earth can that sleep-wrecking, back-breaking implement be connected in any way with the war? Two guesses? Oh, you guessed it the first time, did you?

PROBABLY 5250 planes can handle the bulk of the air transport industry of this country after the war as compared with 350 used prior to the war, said William A. Patterson, president of United Airlines in a recent University of Chicago Round Table discussion of the airplane and its future with Waldemar Kaempffert, science editor of New York Times, and Louis Wirth, professor of sociology at the University of Chicago. Mr. Patterson estimated that within five to seven years following the war, air lines might increase their volume of business to where they would have two-thirds of the first-class Pullman business, possibly one-half of all first-class mail and possibly twenty-five per cent of the express. These, of course, are very conservative figures but in view of all the hoopla that has been going on about the tremendous expansion to be expected in the use of airplanes for every conceivable purpose, the conservatism of the estimate is rather startling. Considering our present highly-publicized capacity for airplane production, 5250 planes are not very many. Yet that number, Mr. Patterson estimates, would handle the bulk of the air transport on a tremendously expanded basis.

A NUMBER of vital messages concerning service men killed in action, reported missing or taken prisoner of war, as well as a large number of undelivered allotment checks, have been received in Washington in the past few months stamped "Unclaimed". At the request of the War and Navy Departments, Red Cross Home Service is attempting to trace the persons to whom these messages were originally sent. This is sometimes a tedious process. All persons listed as "next of kin" on service records are urged by Red Cross officials to leave their forwarding or emergency addresses with the post office when they move.

LIEUT. GEN. BREHON B. SOMERVELL, Commanding General, Army Service Forces, discusses the progress of the war with members of the National Conference of Business Paper Editors at a meeting in The Pentagon during the group's March visit to Washington, D. C. On the General's right is Paul Wooton, president of the editors' organization. At (A) is Kingsley L. Rice, Power Plant Engineering's president and at (B) is Chester R. Earle, associate editor. The General's dry humor flashed over while telling all about [redacted]

(Official U. S. Army Photo)

FOR MANY YEARS, I have heard much talk about the proper place of the engineer in our society. I have heard a great deal about how the engineer should do this, should be recognized as that, how he should have the leadership. I have never altogether subscribed to much of that talk, because I have never believed that leadership is a right. Leadership is a power. It will be exercised by those who are capable. The fact that a man is a doctor, or a lawyer, or an engineer, or a politician, or a clergyman has nothing to do with his leadership. This is simply an indication of his special training. He will be a leader who has and applies the qualities of leadership. No matter what may be his training, or background, or walk in life, that man will be a leader who can and will lead. And many engineers have led, not because they were engineers but because they were leaders. — Willard Chevalier in address entitled A Chance and A Challenge before the 50th Annual S.P.E.E. Meeting, June 1942.

MODELS are no longer required to be submitted with a United States patent application but for many years they were required. Therefore the recent interesting exhibition and sale of United States patent models held at the Architectural League, New York City, was of considerable importance. These models, disposed of by Congressional authority in 1925, were all sold to Sir Henry Wellcome, who apparently intended to make the collection a gift in memoriam to all the people of the United States and to erect a vast museum building to house them. Sir Henry felt that these models were the only visible historical record of early American industry and ingenuity. Sir Henry's death in 1936 made this project impossible, but from his estate the models have passed into the hands of a group headed by O. Rundle Gilbert of 505 Fifth Avenue, New York City. One of the interesting things brought out by this exhibit was the fact that many items invented in 1875 did not come into common usage until 1925, evidence that inventors were from 50 to 75 years ahead of their time. It seems to us that the first installation of an air preheater on a stationary boiler was made in the 1880's at one of the textile mills in Lawrence, Mass., by Howden, its inventor. We have been told that the slag tap furnace for use in boilers was also invented about that time.

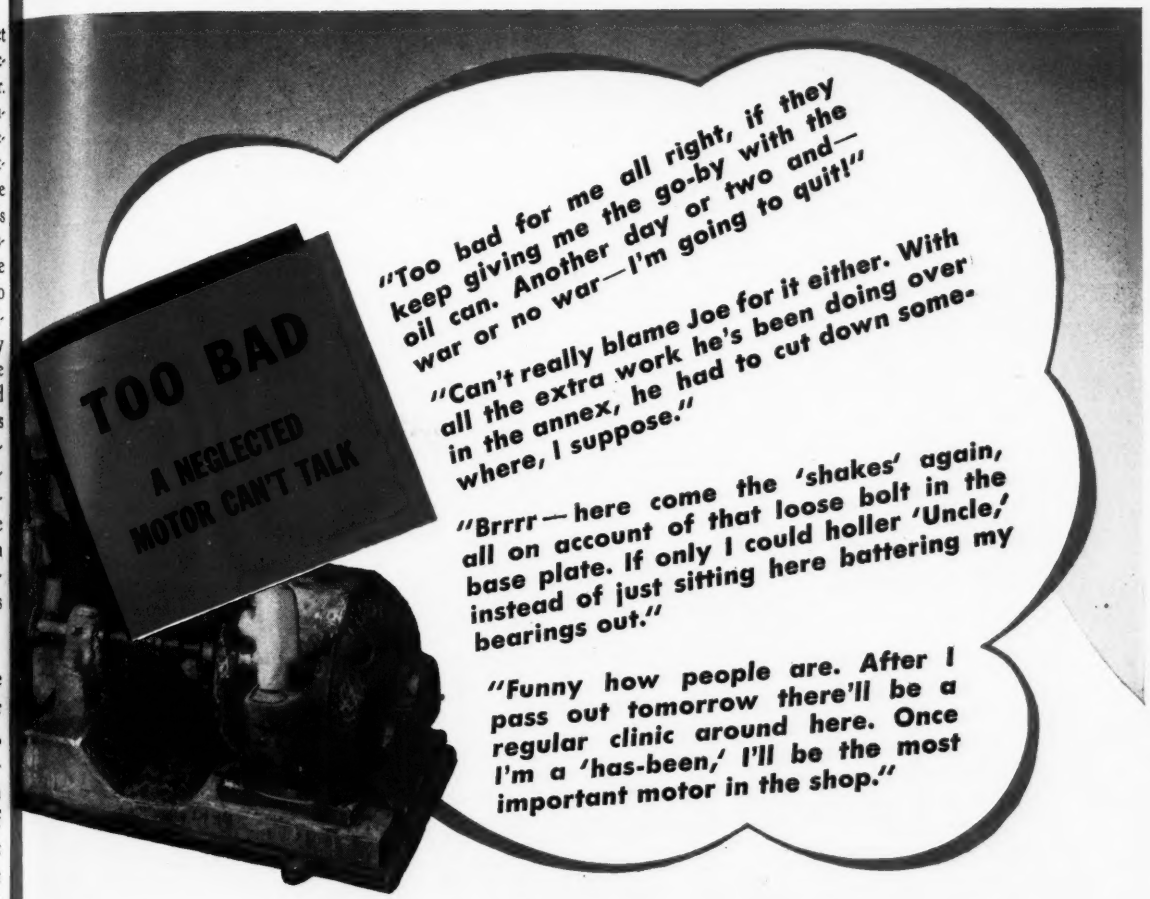
DR. EDWARD C. ELLIOTT, has resigned as chief of the WMC Professional and Technical Service, Bureau of Training, because of increased pressure of duties as president of Purdue University. He will continue temporarily as chairman of the Joint Committee for the Selection of Non-Federal Educational Institutions.

IF YOU THINK a vacuum of 29.996 in. of mercury is high, as produced by an Elliott four-stage injector in the early 1930's, you ought to read the details of the equipment used in producing vitamins, in which pressures are maintained of one micron. One micron is 0.001 of a millimeter, which is 0.00004 in. Hg absolute or a vacuum of 29.99996 in. Hg referred to a 30-in. barometer. Equipment operating at such pressures is used in producing vitamins from fish-liver oil and other animal and vegetable oils, as described in the Autumn, 1942, Powerfax.

A MERRY-GO-ROUND system of group ultraviolet ray irradiation, adapting British methods for reducing absenteeism due to sickness, is announced by Dr. Charles Engelhard of Hanovia Chemical and Manufacturing Co. for use in American war plants. To receive application, the workers stand on a circular platform that revolves around a special high-pressure quartz health lamp supported by a pedestal column. This lamp is set so that the ultraviolet rays are equally distributed to each of eight to ten people standing on the platform. The merry-go-round may also be equipped to furnish musical accompaniment in addition to the artificial sunlight. Rotation of the platform is automatically timed to give each person on it the regular five-minute treatment approved by medical authorities. It is claimed that this device is an improvement on the Hanovia Co.'s installations in Great Britain which have reduced absences due to sickness as much as 60 per cent. Dr. Engelhard presents a vast array of testimony from various individuals and organizations in Great Britain on the effect of artificial sunlight treatment of workers, in blacked-out factories, in toning up the workers generally, preventing colds and minor illnesses and thus greatly reducing absences from these causes.

ECONOMIC HERESY rears its ugly head in the business press! Page Col. McCosmic! Call for Martin Dies! Mobilize the N.A.M.! Just listen to this, taken from The Blue Knight of Roxalin Flexible Finishes, Inc.: "During the last few months, American business men have learned that there are two ways of doing everything, the regular way and the government way. They are different, often entirely different, but those who have had the most to do with the government ways have experienced a growing respect for them. Government procedure is far more efficient than the layman likes to admit. Much of the red tape found in government is found in our own industrial and financial organizations and the scope of their activity is nothing compared to that of the government. You can't run the public business of a hundred and thirty million people the way you would run a filling station."

UNDERWATER resistance welding has replaced many of the routine processes of soldering or brazing of standard copper cable to terminals. This modification of a standard welding process has saved considerably in production costs at Westinghouse by raising output and improving the quality of finished products. Essentially, the process consists of welding by means of special tips and having a stream of water playing on the stranded wire near the electrode. Water is applied at a volume sufficient to cool the work and prevent oxidation at the weld. The wire cable remains flexible to the point of weld in the underwater resistance weld whereas in soldering or brazing the molten metal cools after being drawn into the hot cable by capillary action. Cooling the parts with water not only makes handling easier but heat is removed from the immediate area of the weld rather than passing to more distant areas. Thus the original properties of the individual parts are not changed.


TOO BAD
A NEGLECTED MOTOR CAN'T TALK
"Too bad for me all right, if they keep giving me the go-by with the oil can. Another day or two and—war or no war—I'm going to quit!"
"Can't really blame Joe for it either. With all the extra work he's been doing over in the annex, he had to cut down somewhere, I suppose."
"Brrrr—here come the 'shakes' again, all on account of that loose bolt in the base plate. If only I could holler 'Uncle,' instead of just sitting here battering my bearings out."
"Funny how people are. After I pass out tomorrow there'll be a regular clinic around here. Once I'm a 'has-been,' I'll be the most important motor in the shop."

Preventive Care of Motors

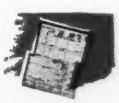
. . . IS A MANAGEMENT PROBLEM

HERE'S HOW G.E. CAN HELP YOU SOLVE IT

A regular schedule for oiling, cleaning, and inspection of every motor is half the battle in keeping motors fit.

The G-E booklet "How to Care for Motors" tells what to do and when to do it. You can use it as a basis for issuing definite instructions, and for analyzing the hours of work involved so that your maintenance crews can be adequately staffed. Ask for GEA-2856A.

To get the most out of motors, and to meet new WPB requirements, the required horsepower for every job must be accurately known. On metal-cutting operations, the new G-E MOTORULE is just what you need to determine your requirements. Simple to use, it saves time and saves motor horsepower. Ask for GEL-763.



Free G-E Motor Record Cards (GES-1526A) make it easy to keep a convenient record of the specifications and service history of every motor in your plant.

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Yes, please send me:

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- ☐ G-E MOTORULE (GEL-763)
- ☐ A supply of.....Motor Record Cards (GES-1526A)

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Address.....

City.....State.....

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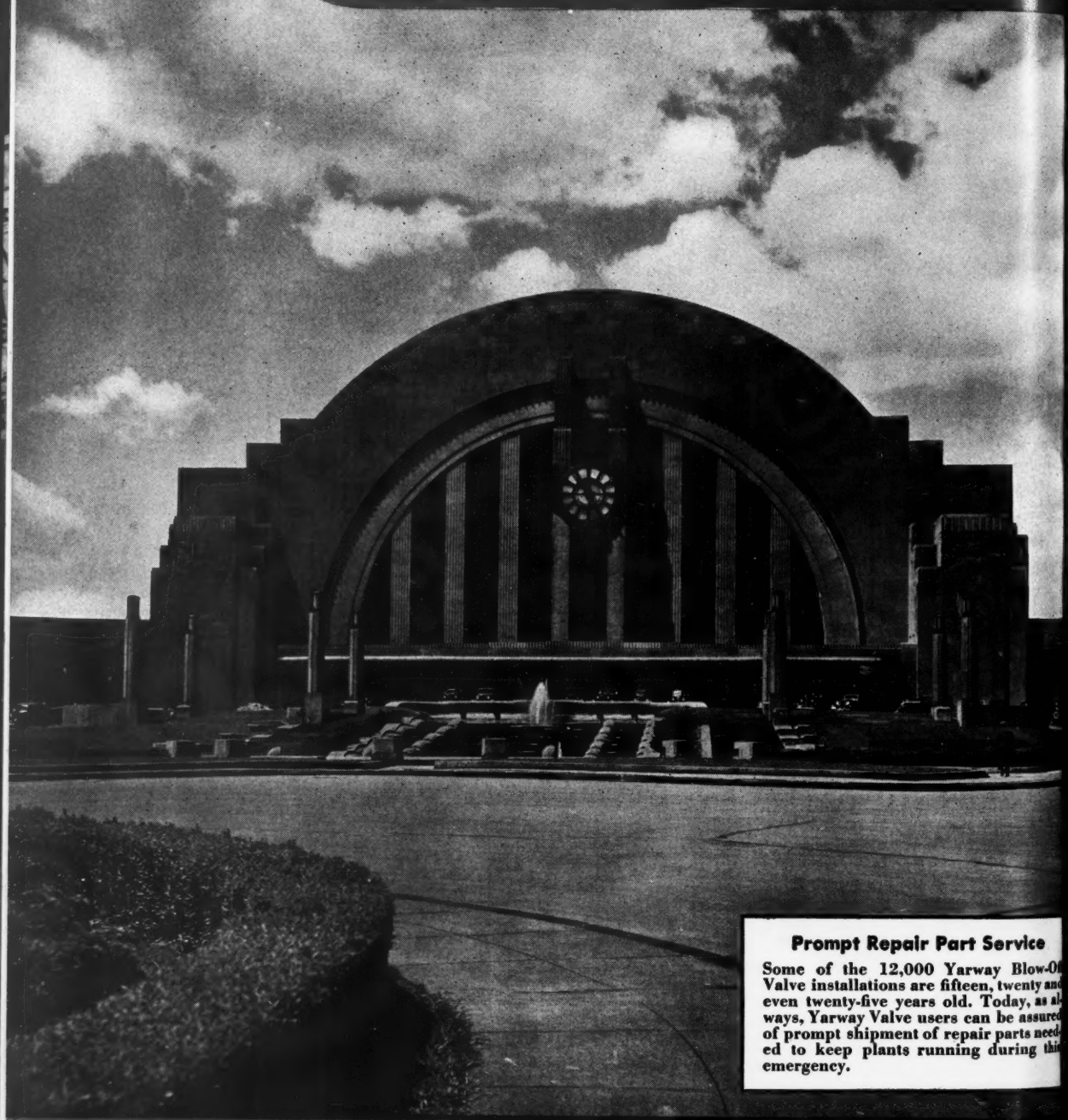
Cincinnati's



Prompt Repair Part Service

Some of the 12,000 Yarway Blow-Of Valve installations are fifteen, twenty an even twenty-five years old. Today, as al ways, Yarway Valve users can be assure of prompt shipment of repair parts need ed to keep plants running during thi emergency.

YARWAY

...and Power
...Beautiful Union Terminal

WHEN the power house serving Cincinnati's Union Terminal was built ten years ago, Yarway Seatless Blow-Off Valves and Yarway Floatless Water Columns and Se-Sure Inclined Gages were selected on the strength of plenty of previous experience with Yarway Equipment. Selected because they had served so well in many plants of the railroads using the Terminal—The Pennsylvania, Louisville and Nashville, Baltimore and Ohio and the Big Four.

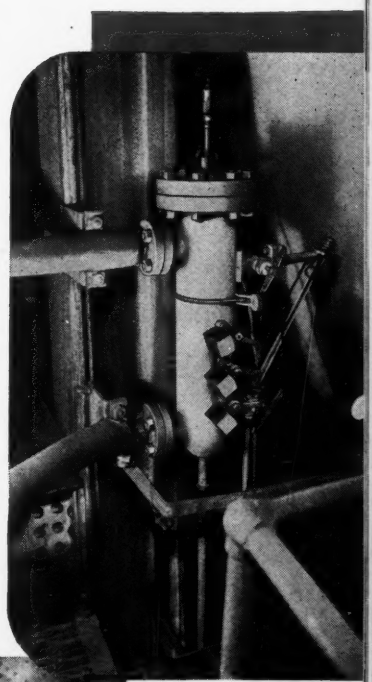
After ten years of fine service involving practically no maintenance, the performance of this Yarway Equipment at Cincinnati has well justified the confidence placed in it.

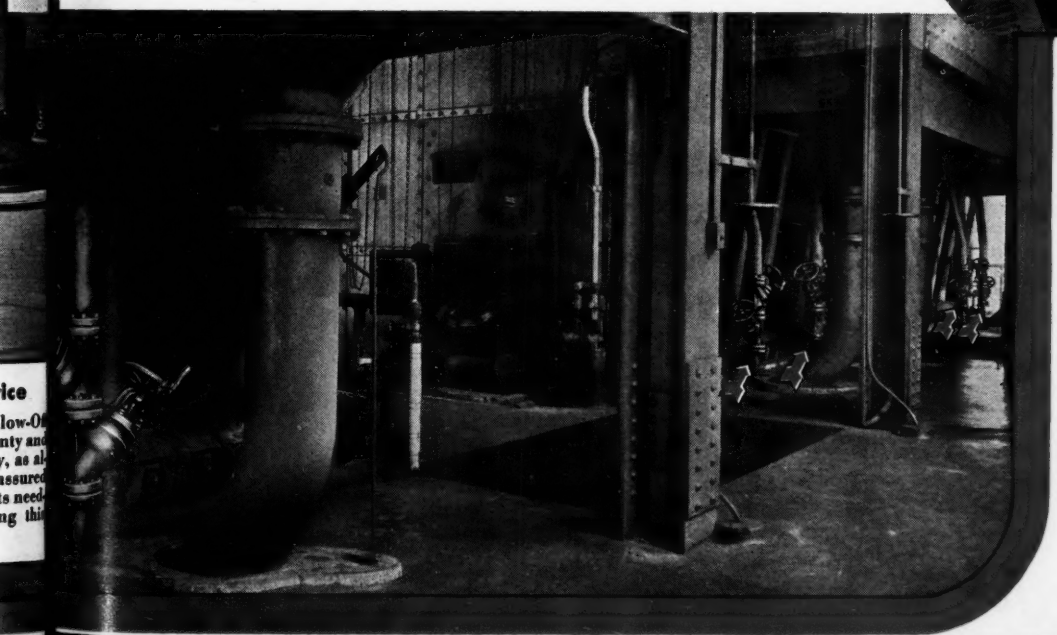
Railroads require dependability above all else in the equipment upon which they rely to provide the most dependable transportation service in the world.

Isn't this the type of year-in and year-out positive protection you want for your boiler investment; the *trouble-free—maintenance-free* service that reduces operating costs?

Write for Blow-Off Valve Catalog. Section B-422 for pressures up to 400 lbs; section B-431 for higher pressures. Water Column and Gage Catalog WG-1809.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia





(*Above*) One of the three Yarway Hi-Lo Alarm Water Columns and Se-Sure Inclined Gages used on the three boilers at Cincinnati Union Terminal.

(*At left*) Six sets of 2½", Fig. No. 3488-3488 Yarway Seatless Tandem Valves are in use at the power plant of the Cincinnati Union Terminal—three sets on boiler blowdown lines and three sets on water wall drains.

BLOW-OFF VALVES

"if you'll pass it on to us!"

So say the Marines . . . and our fighting men everywhere. They'll pass on the ammunition, if we'll pass it to them.

Maintain capacity war production at top-speed efficiency. Use the best quality packings, gaskets and oil seals—they give the longest service and help you avoid frequent shut-downs.

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THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Manufacturers of GARLOCK Packings, Gaskets and KLOZURE Oil Seals

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

HOW TO SOLVE
Operating Problems with Correct Lubrication
HIGHLY POLISHED SURFACES LIABLE TO CORROSION...WEAR
MUST SEAL OUT DUST ... PREVENT LEAKAGE

Prevent Corrosion & Pitting

AFTER YOU'VE DECIDED to use Gargoyle BRB Greases for ball bearings you can go back to getting out production and be assured *that* problem is solved.

These greases do not break down and form the deposits which lead to corrosion and pitting.

In fact, their reliable stability allows bearings to go through periods of a year or more without repacking.

In addition, these greases do not change in structure within wide temperature ranges.

Here are greases you can *depend* on! This has been proved in thousands of applications under operating conditions.

You've solved an important operating problem when you let the Socony-Vacuum man who calls on you specify Gargoyle B RB Greases for the ball bearings in your plant.

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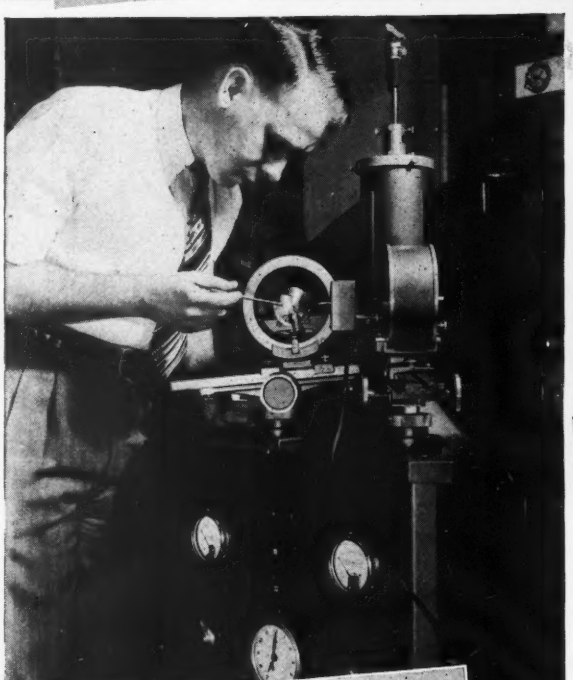
GARGOYLE Lubricants

CALL IN SOCONY-VACUUM

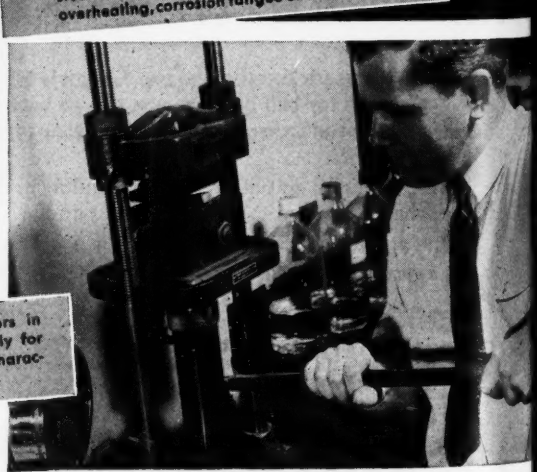
How Hall Boiler Clini

1 **A CORNER OF HALL LABORATORIES'** engineering service laboratory where boiler scales, sludges and waters are subjected to critical examinations.



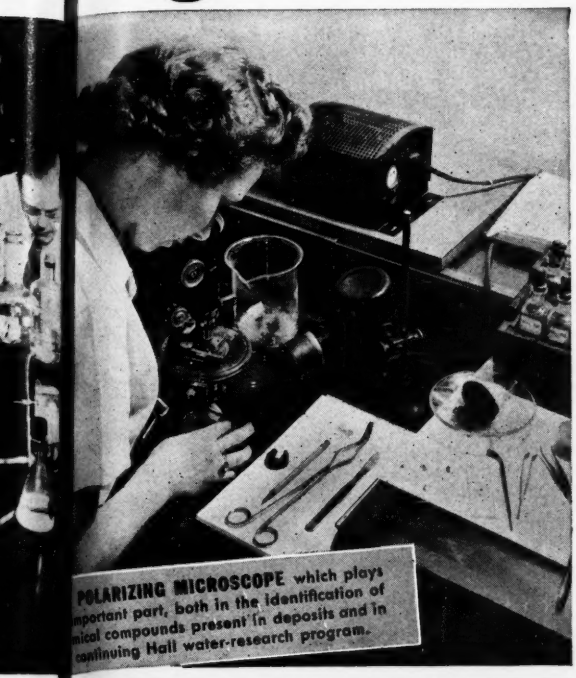
3 **X-RAY EXAMINATION,** in conjunction with chemical analysis and microscopic examination, completes the work of identification.

4 **THE METALLURGICAL MICROSCOPE** becomes indispensable when metal structure must be studied to determine if damage was caused by overheating, corrosion fatigue or embrittlement.

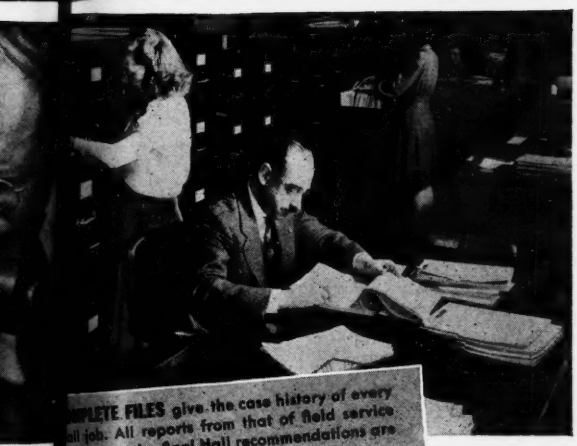


5 **SPECIMENS** from embrittlement detectors in hundreds of plants are checked regularly for cracking, to determine the embrittling characteristics of the boiler waters.

...afeguards the "steam front"!



POLARIZING MICROSCOPE which plays important part, both in the identification of chemical compounds present in deposits and in continuing Hall water-research program.



COMPLETE FILES give the case history of every Hall job. All reports from that of field service engineer to the final Hall recommendations are centered here for immediate reference.

Hall Service in a Nutshell

... your immediate disposal are placed the technical knowledge and facilities of the pioneering leaders in scientific boiler water conditioning. In addition, with your full cooperation, Hall Service:

- Minimizes boiler outages caused by water.
- Helps maintain highest efficiency.
- Establishes non-embrittling water.
- Minimizes carryover.
- Prevents corrosion in boilers and associated equipment.
- Prevents deposition in water lines and cooling systems.

What these famous laboratories, expertly staffed and fully equipped, do to provide protection for America's power plants.

HAVE you ever heard of a boiler clinic? Well, there has been one in continuous operation ever since the beginning of Hall Power Plant Service. Its "out-patients" are the nation's industries. To its laboratories for diagnosis and remedy come the victims of scale, corrosion, carryover and embrittlement. In its files is the most unique collection of case histories in the world—the behavior record of countless boilers.

That is why the Hall field engineer approaches your need with such confidence. He knows that however difficult the problem he meets, if he can't solve it on the spot, the laboratories he represents can and will provide the correct technical answer.

The moment you become a Hall client this clinic starts functioning and your boiler's case history begins. Month by month, as the field reports come in, the story of the conditions you face builds up, the things you were helped to do to give you the right preventive care, the results you got from doing them.

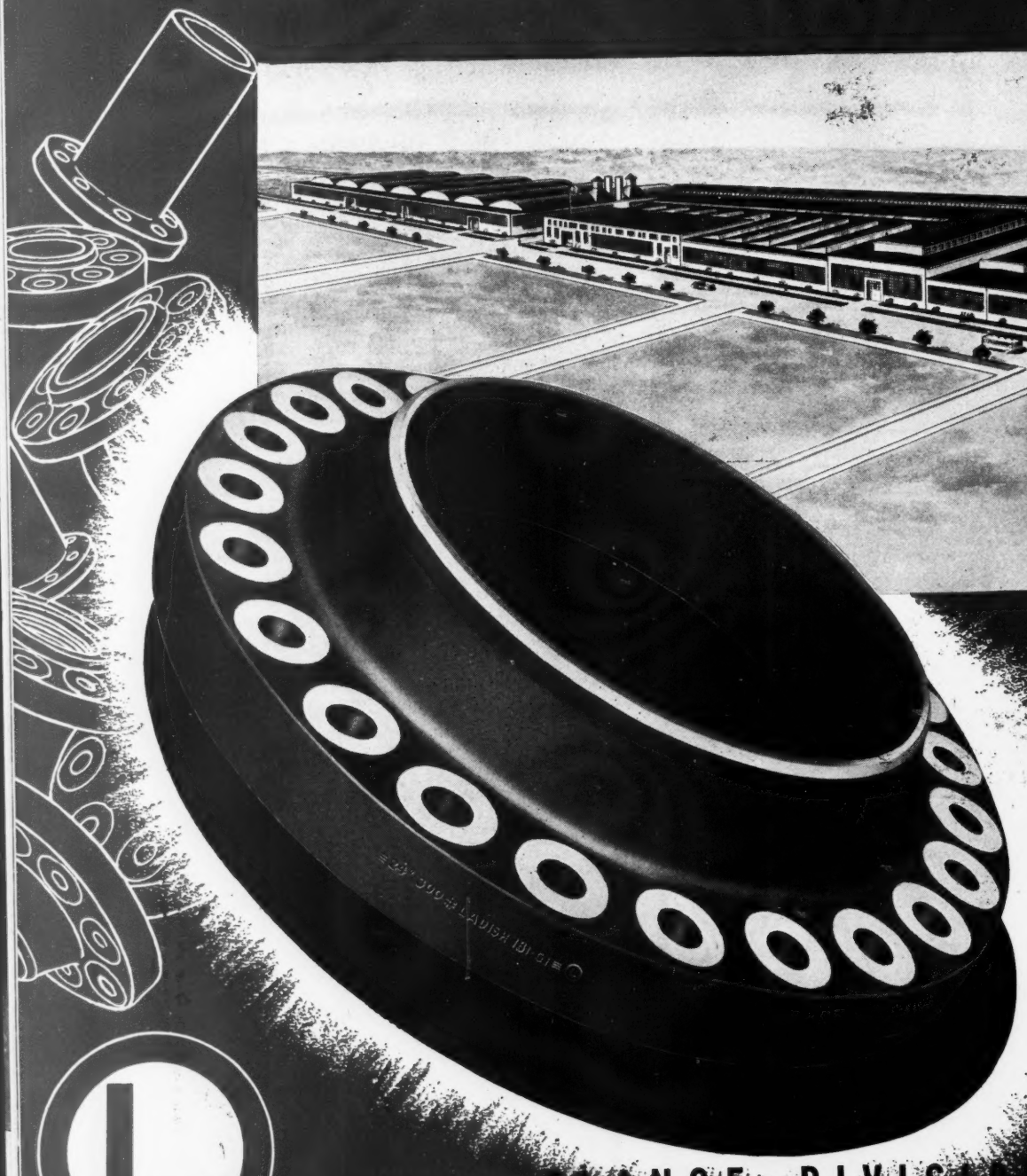
To hundreds of Hall preventive-care clients the work of this clinic has long been a matter of simple routine—they haven't known an unscheduled boiler outage caused by water in years. They found, just as you would, that when the right things are done at the right time, most boiler trouble can be prevented.

Safeguarding the "steam front" has been our job ever since Hall specialists pioneered in this field. Today, it is one of the most vital contributions that can be made to America's productive effort. Why not write for full information?

HALL LABORATORIES, INC.
A subsidiary of Hagan Corporation
HAGAN BUILDING, PITTSBURGH, PA.

HALL SYSTEM
of Boiler Water Conditioning
HAGAN HALL BUROMIN CALGON

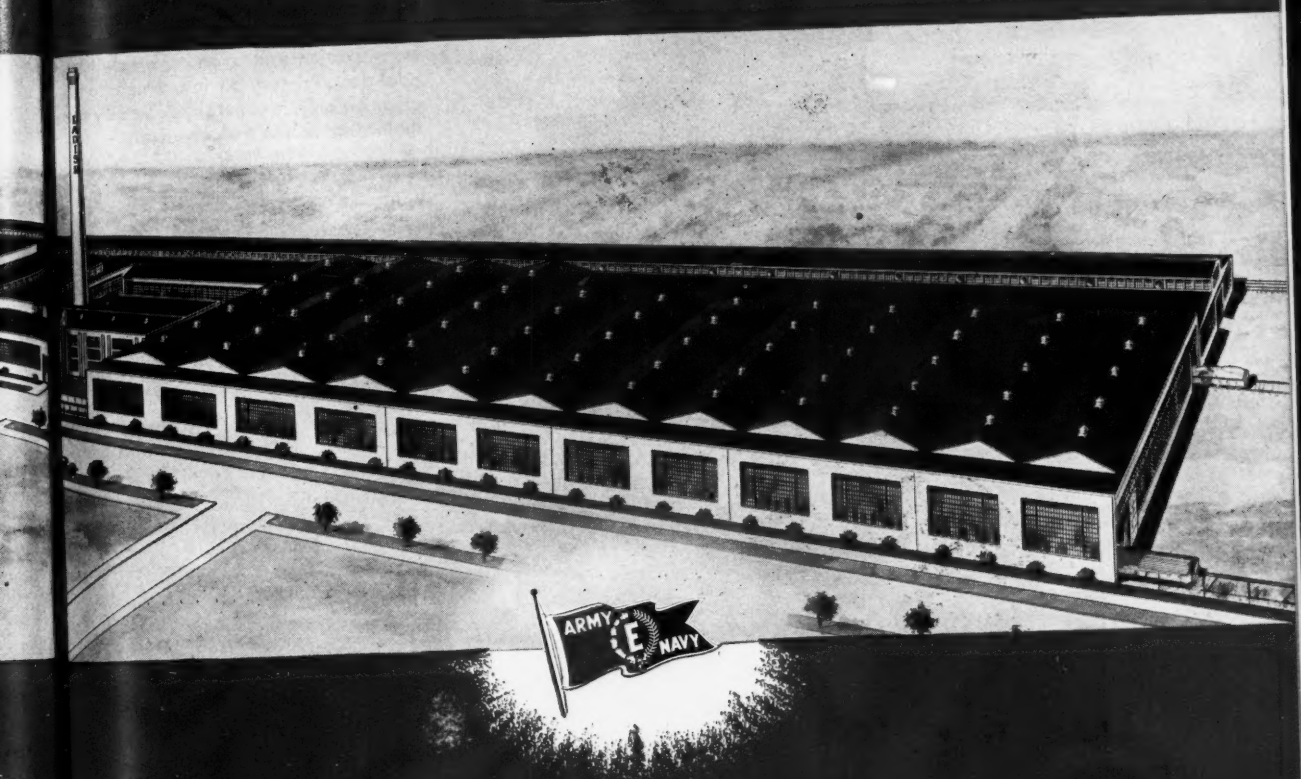
Effective J



FLANGE DIVISION

TO MARK PROGRESS

July 15th



• After many years of marketing its forged steel flanges through one exclusive sales organization, AMERICA'S LARGEST PRODUCER OF FORGED STEEL FLANGES will sell through its own sales and distributing organization, beginning July 15, 1943.

•

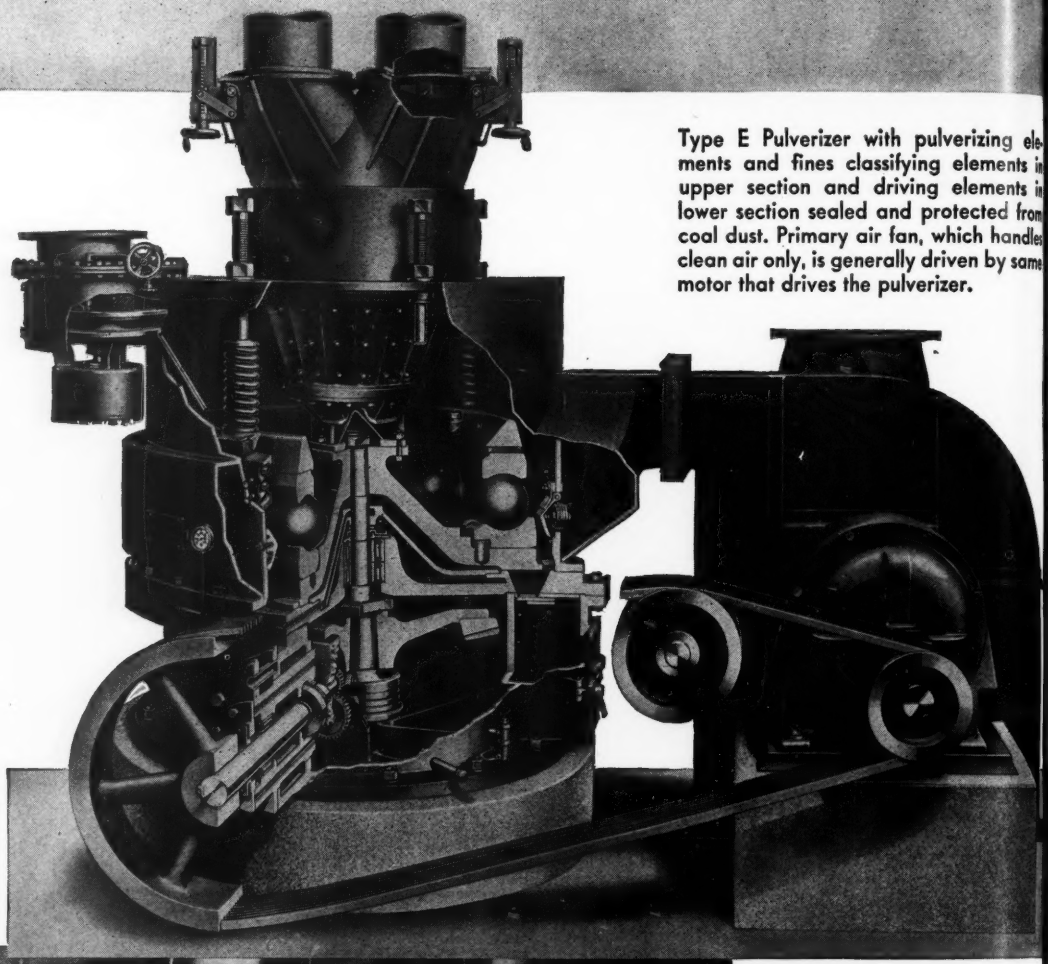
DISTRIBUTORS . . . Limited territories will be available.

LADISH DROP FORGE CO.

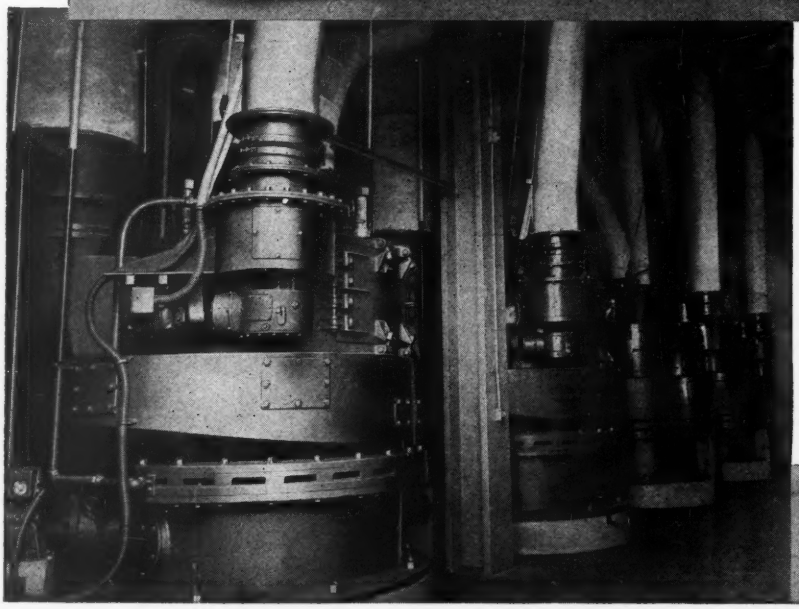
PLANT AND GENERAL OFFICES: CUDAHY, WISCONSIN

MILWAUKEE SUBURB

The B&W



Type E Pulverizer with pulverizing elements and fines classifying elements in upper section and driving elements in lower section sealed and protected from coal dust. Primary air fan, which handles clean air only, is generally driven by same motor that drives the pulverizer.



Over 400 Type E Pulverizers on service or on order for direct fi boilers. Individual installations h as many as 16 units.

ype E Pulverizer

s into Any Day's Fuel Picture

Operates reliably and effectively in direct-firing pulverized-coal systems

By every standard of direct-firing pulverizer performance, the Type E Pulverizer fits into the fuel economy picture any day, and especially so during the present emergency requirements.

Type E Pulverizers—

Are reliable in service and low in maintenance, as measured in service hours before replacement of parts becomes necessary.

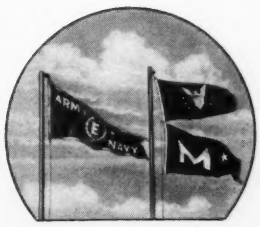
Respond readily to load changes—output controlled at one point, the primary air damper, and are adoptable to fully automatic control.

Maintain fineness and capacity throughout life of grinding elements.

Handle coal of a wide variety and, due to drying in the mill, can handle coal with as much surface moisture as it will carry.

These and other features of the Type E Pulverizer are given in more detail in Bulletin G-30-A. Copies obtainable on request.

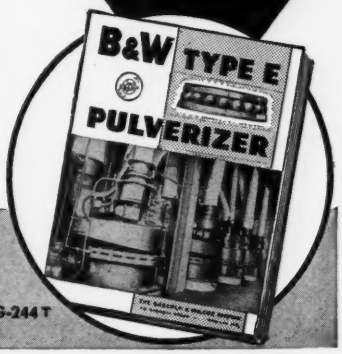
THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET, NEW YORK, N. Y.



The Army - Navy "E" and Maritime Commission Award flags are floated proudly at the plant that builds Type E Pulverizers.

-bearing grinding element
the Type E Pulverizer.
ple—Sturdy—Efficient.

For a copy of this bulletin return this pasted on a penny post card with your name and address.



ABCOCK & WILCOX

G-244 T

Progress and Power in th

Industries, constantly expanding to supply more and more of the materials needed to win the war, have called on America's power producers to supply electric energy in tremendous amounts to turn the wheels.

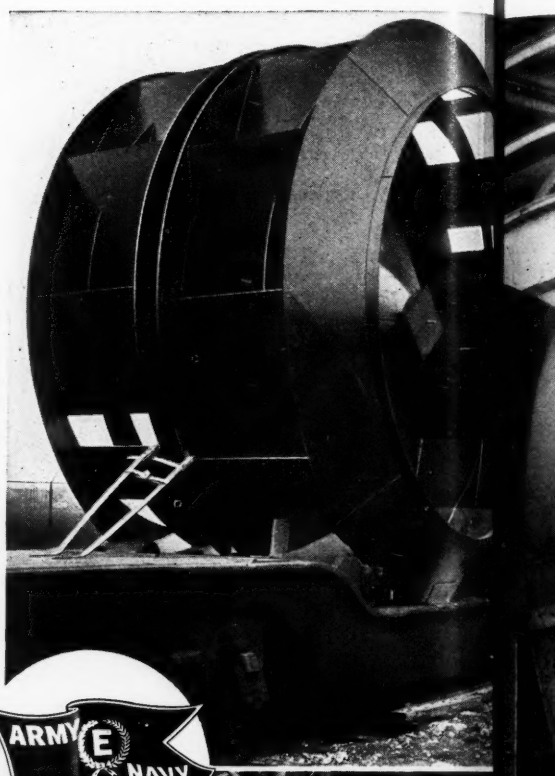
The Utilities of America are equal to the task. Through the greatest network of power lines under one Flag, pulse the life streams of electric energy into the plants of the smelting industry and countless others.

American Blower Mechanical Draft Fans, Dust Collectors and other air handling equipment, and Fluid Drives, are serving both the Utilities and the war industries. We are continuing to build more and more of this vital equipment to meet the needs of America on the march to Victory.

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICH.
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.

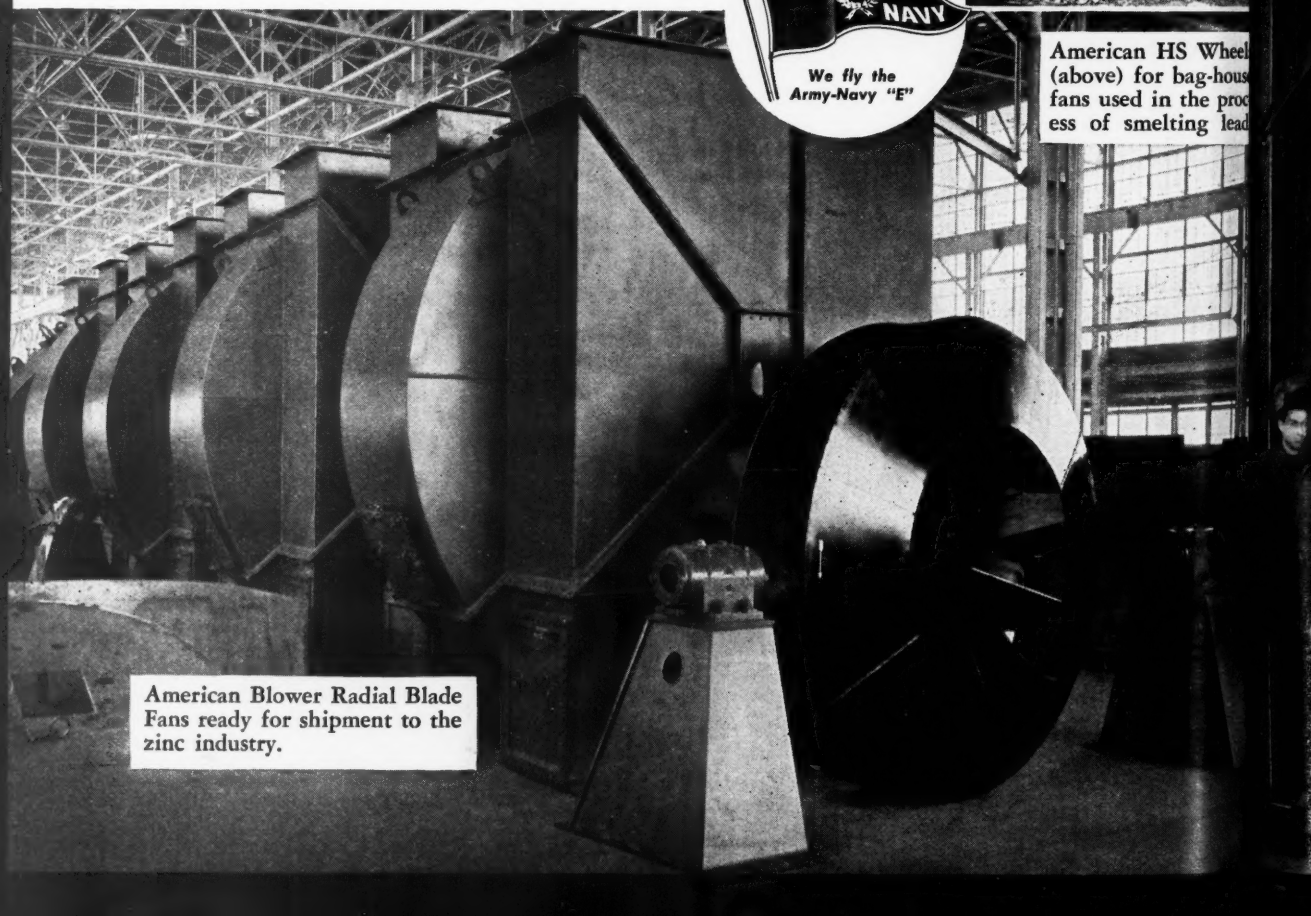
Division of AMERICAN Radiator and Standard Sanitary Corporation



ARMY E NAVY

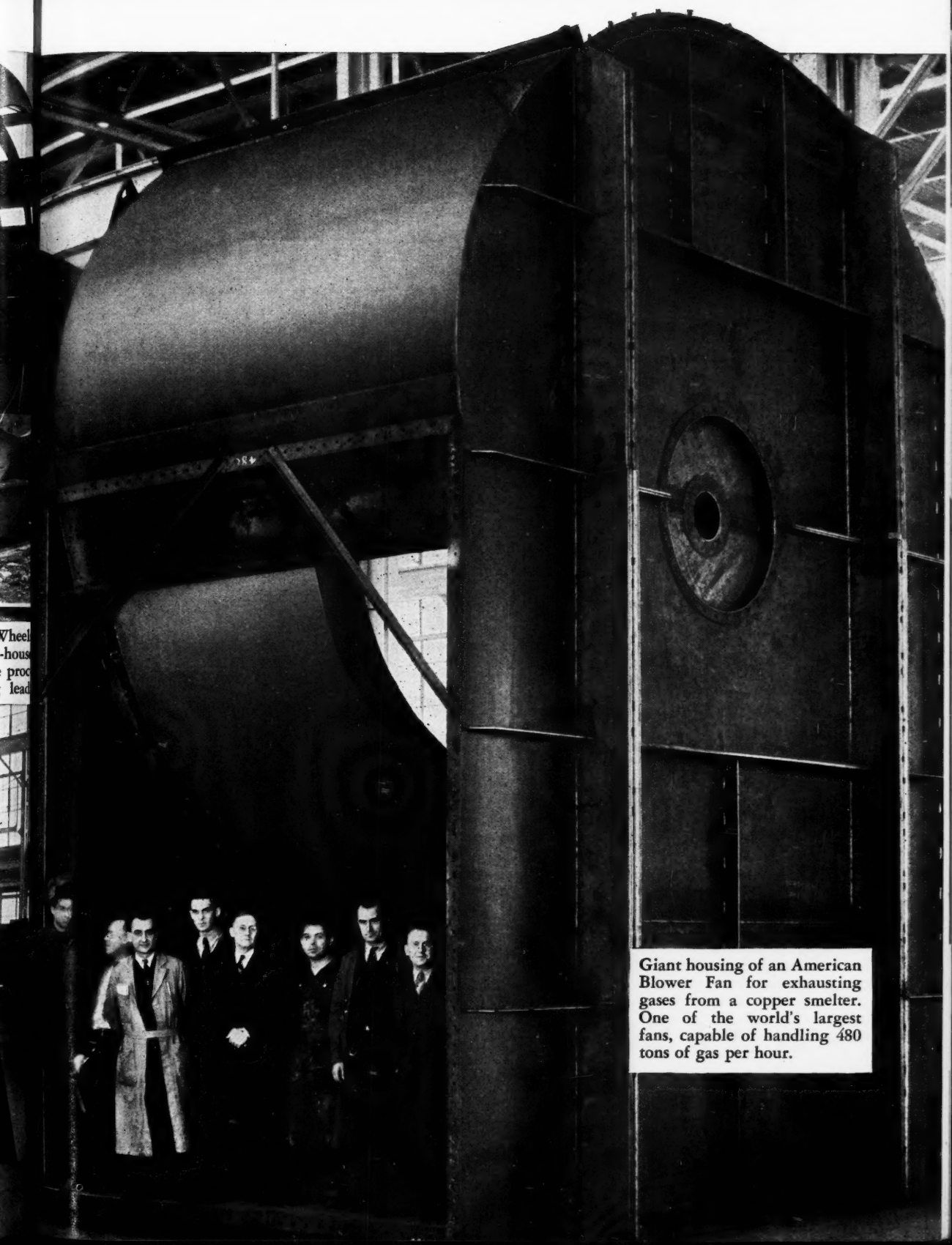
We fly the Army-Navy "E"

American HS Wheel (above) for bag-hous fans used in the proc ess of smelting lead



American Blower Radial Blade Fans ready for shipment to the zinc industry.

SMELTING INDUSTRY



Giant housing of an American Blower Fan for exhausting gases from a copper smelter. One of the world's largest fans, capable of handling 480 tons of gas per hour.

Timely change from oil to coal made possible by recent Taylor Stoker Installation

BECAUSE of the adaptability of A-E-CO Taylor Stokers to changing conditions, an important power plant will soon reduce the national consumption of oil by 10,000,000 gallons a year.

The boiler and firing equipment for this plant were purchased in 1941 to burn oil—but the furnace design was predicated on a partial or entire conversion to coal should conditions make such a conversion desirable.

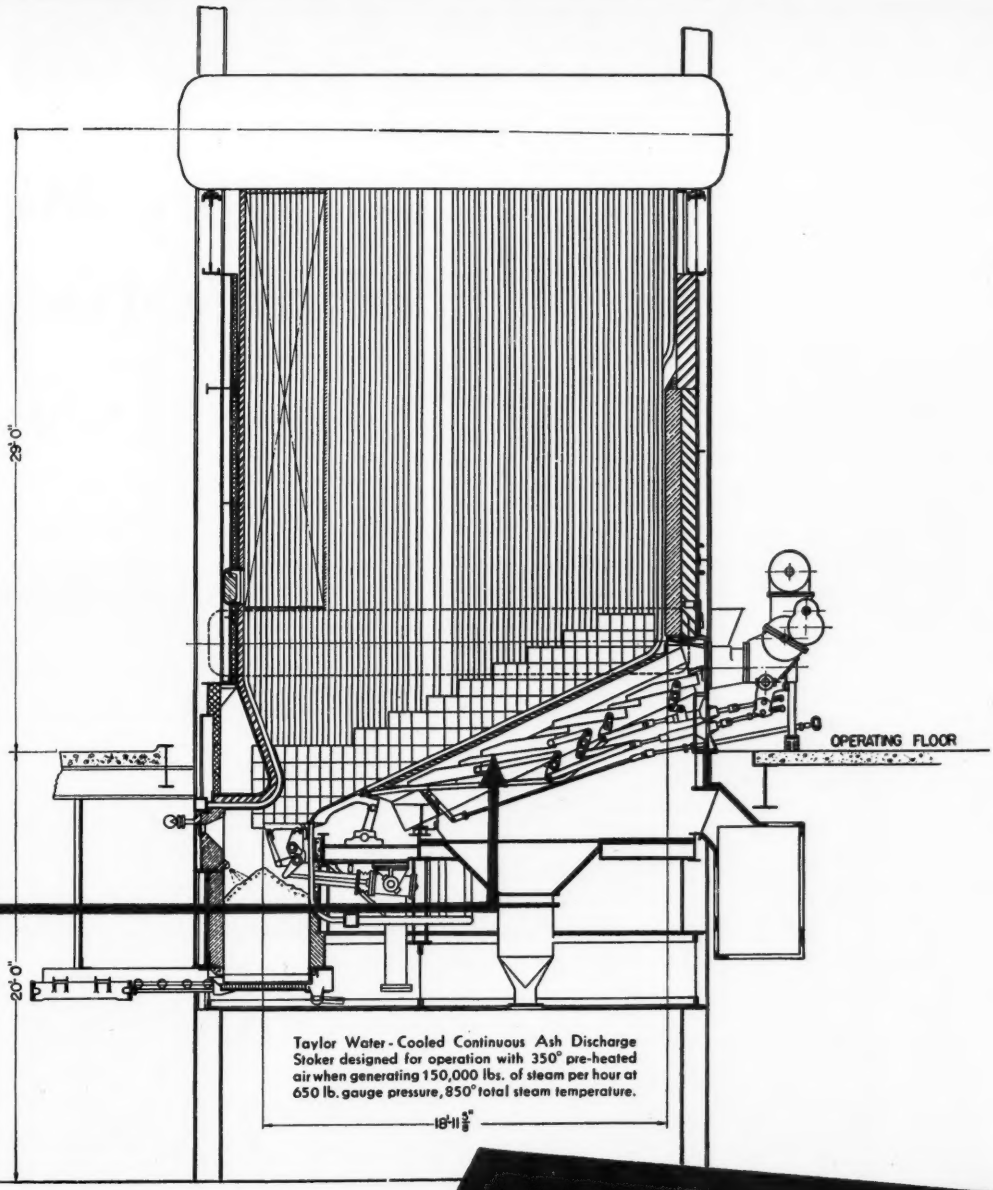
Because of the foresight on the part of the management of this plant, the oil shortage will not disrupt their production. The Taylor Stoker being installed will meet the emergency conditions imposed by war as it will the economic conditions of the peace to follow.

JUDGE THE SELECTION OF FUEL FIRING EQUIPMENT BY THESE TWELVE POINTS

1. **RELIABILITY**—the ability to operate with minimum outage and minimum standby equipment.
2. **CAPACITY**—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.
3. **MAINTENANCE**—the ability to operate continuously with minimum repair costs.
4. **FLEXIBILITY**—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.
5. **EFFICIENCY**—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.
6. **OPERATION**—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.
7. **ADAPTABILITY**—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.
8. **FUEL FLEXIBILITY**—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.
9. **REFUSE DISPOSAL**—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.
10. **STACK DISCHARGE**—the practical elimination of "smoke nuisance" without special equipment.
11. **SPACE REQUIREMENTS**—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.
12. **OBSOLESCENCE** — the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

AMERICAN ENGINEERING CO

PHILADELPHIA • PENNSYLVANIA



Taylor Water-Cooled Continuous Ash Discharge Stoker designed for operation with 350° pre-heated air when generating 150,000 lbs. of steam per hour at 650 lb. gauge pressure, 850° total steam temperature.

A-E-CO TAYLOR STOKERS
WATER WALLS • ASH HOPPERS
HELE-SHAW FLUID POWER
MARINE DECK AUXILIARIES

A-E-CO TAYLOR STOKER

COMPANY

AE CO 75th ANNIVERSARY

WHEN MANPOWER

Bailey Meters

Simplify Training

Send for this Bulletin, No. 16, which tells how to use meters and controls as a basis for daily operation.

One of a group of women now serving operators in a Mid-Western Central Stat

BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPE

BECOMES WOMANPOWER

tend Control Systems
hind Operating Programs

★ When women come to work in the Boiler Room, Bailey Meters and Controls greatly simplify the training and operating programs. By making full use of this equipment, it is possible to maintain high standards of efficiency, continuity of service, and safety in spite of inexperienced operating crews.

New operators quickly learn to use the simple, direct information furnished by Bailey Meters. For example, the Bailey Boiler Meter shows when "too much" or "too little" excess air is being used, simply by the relation of its Air Flow pen to its Steam Flow pen. When Air Flow is above Steam Flow too much air is being used. When it is below, too little air is being used. When the pens coincide, ideal conditions prevail.

Bailey Control Systems go a step farther by interpreting the meter readings and automatically taking the necessary action to maintain ideal conditions. Complete combustion control with sequence interlocks, limit stops, and automatic readjustment of fuel—air ratio, insures the maintenance of fuel economy, uniform steam pressure, and safe combustion conditions. Bailey Feed Water Control likewise aids in securing uniform operation and guards against damage from high or low water.

A discussion on the use of meters and control systems as a basis for daily operation is contained in our Bulletin No. 16, "How to Safely Stretch Steaming Capacity." A copy of this bulletin will be sent to you upon request.

A-89

BAILEY METER COMPANY

1040 IVANHOE ROAD • CLEVELAND, OHIO

BAILEY METER COMPANY LIMITED • MONTREAL, CANADA

BAILEY METERS

e Complete Combustion Control System

ROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

POUR

TYCOL

SCIENTIFICALL

POINT*

*This is [illegible] of a series of informative [illegible] concerning the [illegible] and significance of commonly used tests and terms employed to describe the characteristics of lubricating oils.

TIDEWATER LUBRICANIA

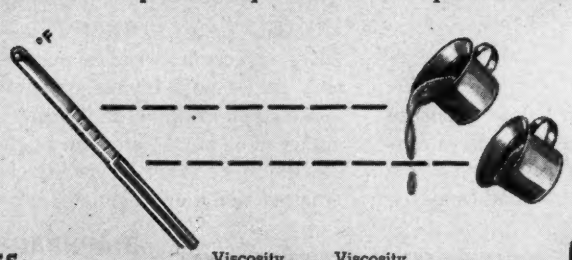
DEFINITION: The pour point is the lowest temperature at which the oil will pour or flow when chilled without disturbance under definite prescribed conditions.

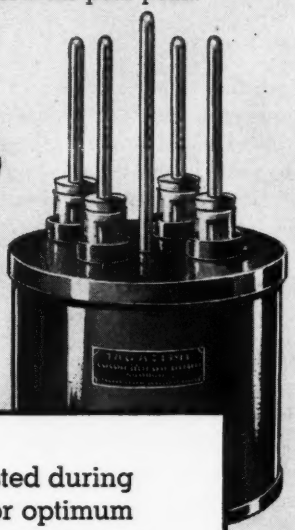
TEST: Following a carefully prescribed procedure with standardized equipment, the oil is chilled in a test jar or a corresponding 4 oz. sample bottle. At each oil temperature reading, taken at 5° F. intervals, the test jar is removed and tilted just enough to ascertain whether or not the oil is still fluid.

A temperature point will be reached at which the oil shows no movement when the test jar is held horizontally for exactly 5 seconds. The pour point is the temperature 5° F. above this "non-fluid" point.

SIGNIFICANCE: The pour point is an indication of the temperature below which it may not be possible to pour oil from its container, or below which it may not flow in gravity lubrication systems. This may be due either to partial separation of wax crystals forming a spongy network or to congealing of the oil itself.

Therefore the pour point bears no relation to the viscosity of the oil at higher temperatures. Neither does it indicate the pressure flow, or the tendency to "channel" at temperatures below the pour point.





EXAMPLES:	Viscosity at 210° F.	Viscosity at 32° F.	Pour
Paraffine Base Lubricant....	70	12,000	25° F.
Napthenic Base Lubricant..	70	50,000	0° F.

Tycol lubricants are rigidly controlled and tested during manufacture to the required characteristics for optimum performance. Among many other tests they must meet the pour point requirements of the individual application.

DRUMS! DRUMS! DRUMS!
War needs make it extremely important that all empty drums be returned immediately.

TIDE WATER ASSOCIATED OIL COMPANY

Eastern Division: 17 Battery Place, New York
Principal Branch Offices: Boston, Philadelphia, Pittsburgh, Charlotte, N. C.
MAKERS OF THE FAMOUS VEEDOL MOTOR OIL

INDUSTRIAL LUBRICANTS

ALLY ENGINEERED FOR EVERY INDUSTRIAL USE

★ ★ ★ **A New Pneumatic**

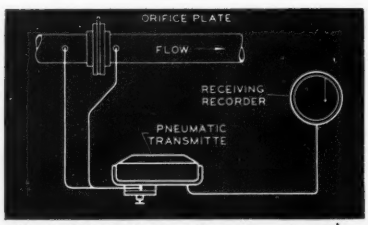
FOR MEASURING FLOW AND LEVEL

Operating on the Force-Balance Principle

The Republic Differential Pressure Transmitter is an entirely new type of pneumatic meter which has been thoroughly field tested during the past two years. It is a simple pneumatic device for converting a differential pressure, such as is produced by the flow of a fluid through an orifice or by liquid level in a vessel, into an air pressure which varies proportionately with the differential pressure.

This air pressure is used as a direct measure of the differential pressure and can be conducted to a remote location by means of tubing. A gage or receiver connected anywhere in this transmission line will show the variations in the differential pressure and may be graduated in terms of the flow or level which it represents. The pressure can also be utilized as the impulse for actuating a controller.

The Republic Pneumatic Transmitter operates exactly like a weigh scale. The force of the differential pressure on a measuring diaphragm is the value being weighed. This force, multiplied by its lever length, is balanced by the force on a reaction diaphragm times its lever length. The pressure on the reaction diaphragm represents the weights used on a scale and is merely a means of automatically accomplishing this weighing process and transmitting the results.



Typical installation for measuring flow.

Typical installation for measuring liquid level.

RANGES—standard ranges are available from 0.9 to 25 in. of water differential, for working pressures to 15 psi.; 7 in. to 50 in. of water for working pressu up to 25 psi.; and 13 in. to 800 in. of water for worki pressures up to 600 psi. Special heads can be provid for working pressures up to 2000 psi.

RANGE EASILY CHANGED—the range of a l public transmitter can be readily changed by makin few minor adjustments or substituting a few sim parts. For example, a transmitter with a differen range of 50 in. of water can be changed to any range to 100 in. of water by merely changing the position the reaction diaphragm.

DIAPHRAGM MATERIAL—d phragms for the Republic transm ter can be made from practically a material including rubber, synthe rubber, Saran, brass, stainless ste Monel, silver, etc. This is possi due to the extremely small moti required. (.010 in. for full scale re ing). The material is specified accordance with the solvent or c rosive action of the measured flu

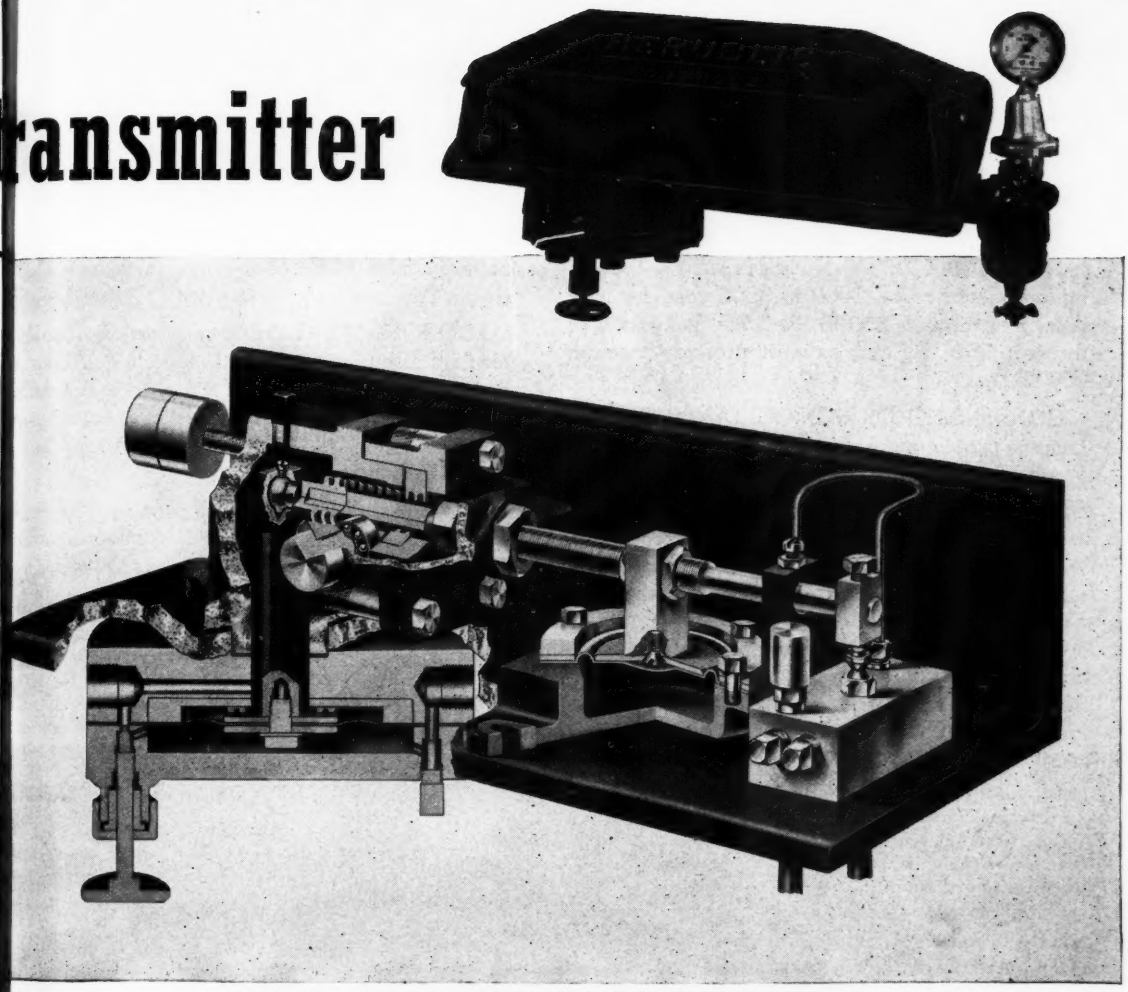
●

For complete details wri for Bulletin No. 43-4

REPUBLI

2224 DIVERS

transmitter



Exterior and cut-away view of the Republic Pneumatic Transmitter.

PERFORMANCE FEATURES

CURACY of the Republic force-balance method of asurement is higher than can be consistently secured l maintained with any other method. Transmitting ssure vs measured differential is guaranteed within ½ % of meter range.

NSITIVITY — due to the negligible motions required complete operation of all parts for full scale change, no preciable hysteresis results from reversal of direction of asurement change. The hysteresis loop is so small that is undetectable by ordinary means, being less than 0 of 1%.

SPONSIVENESS — due to the fact that there is virally no volume displacement, the Republic Pneumatic nsmitter is able to follow flow changes almost instanneously. The time required to produce full output pressre at the transmitter is in the nature of fractions of a cond, after the differential is imposed. Therefore a reving instrument installed adjacent to the transmitter will show flow changes almost instantly. With 500 feet of ¼ in. O. D. tubing, the full value of the change will have registered on a Republic receiver in 15 seconds. This is the overall lag in the system not merely the transmission lag.

NO TEMPERATURE EFFECT — the effect of ambient temperature variations on the accuracy of a Republic transmitter is negligible. Since all parts are equally effected by temperature changes, force and leverage relationships are not disturbed and accuracy is unimpaired.

NO VIBRATION EFFECT — the Republic transmitter is unaffected by any normal frequency of vibration ordinarily encountered in industrial or process plants.

AIR CONSUMPTION — the air consumption of the pneumatic system is .20 cfm. maximum at 20 psi. supply pressure, when differential is zero. At maximum differential consumption is zero and is inversely proportionate to intermediate, differentials.

LOW METERS CO.

RKWAY • CHICAGO • ILLINOIS

heat balance

FROM 100 TO 5000 HORSEPOWER—Type M multi-stage turbines, 1000 to 5500 rpm, for inlet pressures through 650 lb. ga., total temperatures through 750° F., and exhaust pressure through 200 lb. ga.

CONDENSING OR NON-CONDENSING—Heat balance problems are simplified, since any of these Westinghouse turbines can be built to operate condensing or non-condensing.

SAFE—Dangerous overspeeding is prevented. Types C and CH turbines have Dual Protection, which actuates *both* the governor valve and the butterfly valve at the *same time* in event of over speed. Trip lever is sparkless, with a Micarta insert

ECONOMICAL—Blading proportions are the result of extensive research. Blade pitch is uniform Blade shrouding is made conical to approximat the steam expansion characteristic. Nozzle dimen sions are accurate. All this adds up to maximum steam economy.

RELIABLE—Fully protected against corrosion and erosion. Blades and shrouds are chrome-alloy There is no soft packing on the inlet valve stem— hence, no sticking.

DIRECT-CONNECTED—Type C-20 single-stage turbine, showing Dual Protection against overspeed. When overspeed occurs, *both* the governor valve (1) and the butterfly valve (2) are tripped simultaneously.

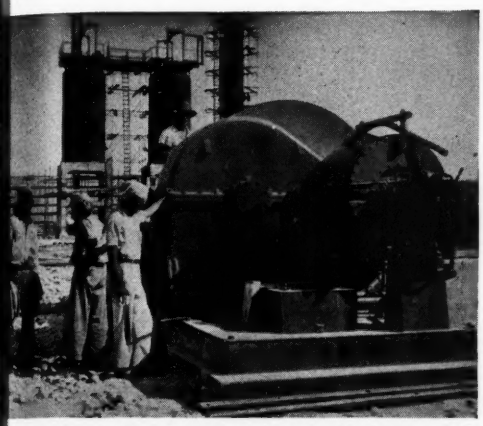
SEND FOR THE BOOK YOU WANT

Booklet 2230 on Type C single-stage turbines. Folder 8574 on Type CH heavy-duty turbines. Booklet 2278 on reduction gears.

WESTINGHOUSE STEAM EQUIPMENT FOR REFINERIES INCLUDES:

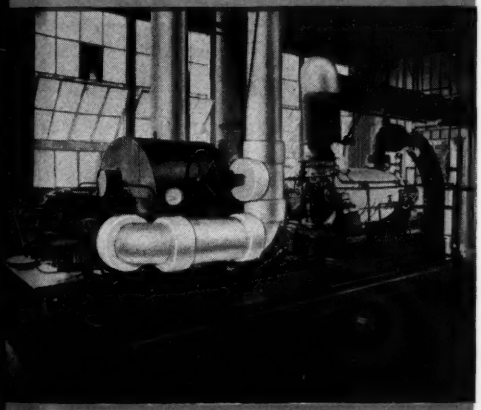
Turbine-generators. Mechanical-drive turbines. Reduction gears. Condensers. Feed water heaters. Air ejectors for condensers and process. Vacuum cooling equipment.

FOR BUTADIENE, STYRENE AND HIGH OCTANE GAS PLANTS

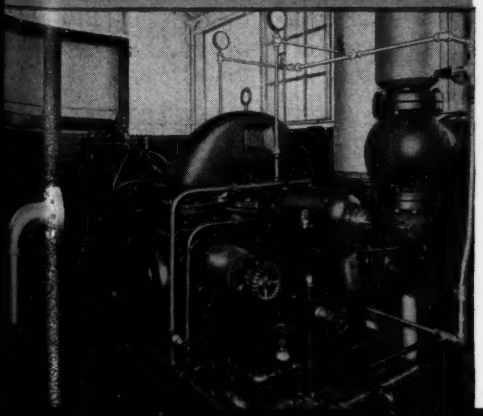


EARED—Type M multi-stage turbine, with close-coupled duction gear, driving a pump in an Iraq refinery. One of venteen Westinghouse turbines installed.

ULTI-STAGE — Type M turbine, with hydraulic orifice vernor, driving a hot oil pump. Nineteen Westinghouse rbines are installed in this Indiana refinery.



INGLE-STAGE — Type C-25 turbine driving a charging mp in a southwestern refinery.



WESTINGHOUSE HAS THE RIGHT TURBINES FOR STEAM DRIVE ECONOMY IN ANY APPLICATION

ECONOMY AND EFFICIENCY of power in any refinery depend to a large extent on proper heat balance. That is why engineers and contractors who plan and build refineries insist on selecting *co-ordinated* steam turbine drives. These drives must deliver the required horsepower at the right rpm for pumps and other driven equipment, using available high pressure steam, and exhausting at reduced pressure to supply the demands of process and heating. And that is why more and more refineries are coming to Steam Headquarters for their turbines. Whatever the variation in size or process, Westinghouse has a complete line of turbines and related steam equipment that will help solve refinery heat balance problems.

FLEXIBILITY OF APPLICATION is possible, because the Westinghouse line includes: (1) single-stage turbines for average efficiencies, and multi-stage turbines for greater steam economy; (2) condensing or non-condensing units; (3) suitable governors to provide any required quality of speed regulation; (4) reduction gears to make possible efficient turbine speeds with the right rpm for driven equipment; and (5) low-level jet, barometric or surface condensers with co-ordinated auxiliaries.

FROM 5 TO 1500 HORSEPOWER—Standard Type C turbines 1000 to 5000 rpm, with inlet pressures through 600 lb. ga., total temperature through 750° F., and back pressures through 50 lb. ga.

FROM 50 TO 2000 HORSEPOWER—Type CH heavy-duty, single-stage turbines, 1000 to 4500 rpm, with inlet pressures through 1500 lb. ga., total temperature through 950° F., and exhaust pressure through 300 lb. ga.

J-50433

Westinghouse

PLANTS IN 25 CITIES ... OFFICES EVERYWHERE

WESTINGHOUSE W

STEAM HEADQUARTERS

Design FLEXIBILITY

TYPICAL HEADER DESIGNS

The wide variety of header designs made possible by the use of cast electric steel is visually demonstrated in the accompanying photos of a few of the large types of Springfield headers.

SPRINGFIELD BOILERS

SPRINGFIELD B

MODERN STEAM GENERATING UNITS

Extra RELIABILITY

ELECTRIC FURNACE STEEL . .

CAST STEEL MEETS ALL REQUIREMENTS

Springfield header steel is produced by the Electric Furnace process with accurate control of chemical analysis. Foundry practices based on over 25 years' experience assures sound castings — — fully annealed before leaving the foundry. Steel in the finished header is ductile as illustrated by the twisted and bent specimens and a 30" long turning produced in boring the header. Analysis and physical properties will comply with all construction Code requirements. Carbon steel, used for most Springfield headers under 600 lbs. working pressure, tests 72,000 lbs. per sq. in. minimum tensile strength. For higher working pressures, strength is increased by use of alloy steel and ranges from 85,000 to 105,000 lbs. per sq. in. tensile strength.

THE development of the use of cast steel for boiler, water wall, superheater and economizer headers is just one of the factors which have established a reputation for Springfield as a builder of more reliable, longer lasting boiler units, and the design flexibility of this construction is the principal reason why Springfield Sectional Water Tube Boilers have a much broader field of application than other sectional header designs.

Springfield boiler headers, proven in service for more than thirty years, have demonstrated fully the following advantages of cast steel construction:

DESIGN FLEXIBILITY

1. Casting process is adaptable to a wide variety of header designs so that headers can be made the desired and proper size and shape to give best results for each particular application.

2. Uniform strength is assured throughout entire header structure by increasing the casting thickness or incorporating reinforcing ribs as required.

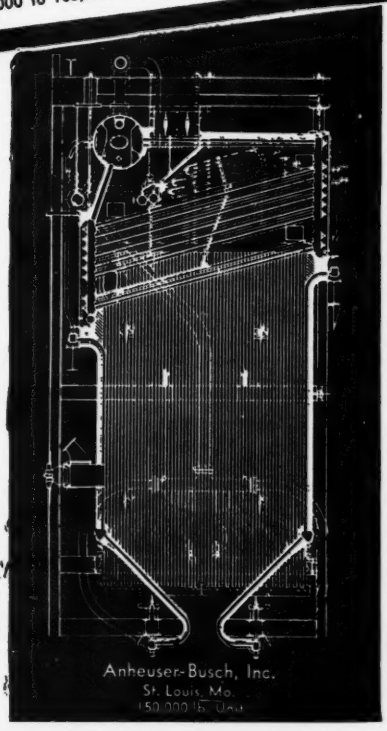
3. Unusual flexibility in design is possible at nominal cost by modifying patterns to meet required conditions.

EXTRA RELIABILITY

1. A tougher metal because, while the finished metal is ductile, it does not have to be as soft as the steel used in headers which are forged or pressed to shape. This means stronger sections, tube holes which will resist tube rolling and form tighter, stronger rolled connections.

2. A stronger metal with yield point and tensile strength 25% greater than in the usual forged or wrought steel.

3. Longer life as no seams or crevices are present to form starting points for embrittlement or corrosion and the cast surfaces are, by nature, corrosion resistant. Pitting or corrosion has never been reported in Springfield headers.



Write to Springfield today for complete data on boilers to meet your requirements. **SPRINGFIELD BOILER COMPANY, 1951 E. Capitol Avenue, Springfield, Illinois.**

BOILER CO.

ANY SIZE • ANY FUEL • ANY PRESSURE

IF IT'S PIPING CONTACT FLORI

The construction of a power dam requires huge quantities of fabricated pipe and plate steel products . . . All this is within our scope

Fabricated Piping—for steam, water, air, oil, gas, chemicals • Random mill or cut lengths, bent, coiled, threaded, welded, flanged • Valves, Pipe Fittings

In brief: anything in tubular or plate steel fabrication. Send your inquiries.

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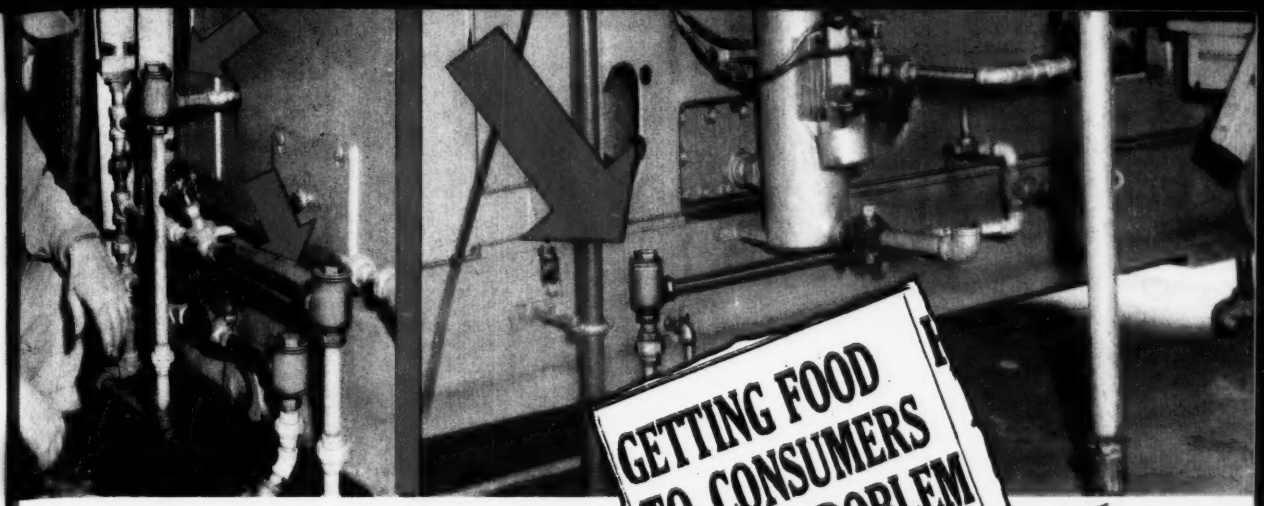
THE FLORI PIPE COMPANY • ST. LOUIS—CHICAGO



it's a Steam-Process

SPEED UP WITH

SARCO No. 9 Steam Traps

Whenever you see a cluster of Sarco No. 9 Steam Traps you can be sure of several vital features in the equipment they serve.

1. No one steam coil can hold up another. They are all working at top speed.
2. No useful heat is escaping with the condensate. The No. 9 expels only the slightly cooled condensate.
3. There's no trouble starting up. It discharges all entrained air rapidly, being wide open when cool, which is also why it can't freeze.
4. Varying steam pressures will not affect the operation. No seats to change. It's the only thermostatic steam trap made for pressures up to 250 lbs.

This trap has been carrying heavy loads in all types of process industries and on heating lines for a quarter of a century.

Try one in a tough spot and you will see the reason why.

The No. 9 has a powerful, snappy action due to the heavy wall, helically corrugated bellows made from flat blanks exclusively in the Sarco Factory at Bethlehem, Pa.

SARCO Saves Steam

SARCO COMPANY, INC., 475 FIFTH AVENUE, NEW YORK

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

Represented in Principal Cities

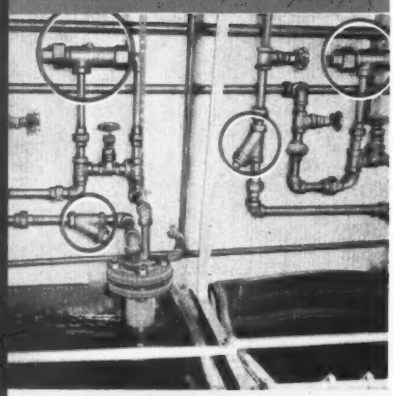
Simple

Temperature Contro
for Industr

Elaborate equipment is not necessary to secure the ad
tages of automatic control of critical temperatures.

Sarco has made available simple, self-operated r
lators which are providing adequate control on hund
of applications at astonishingly low cost.

Take these three examp



A manufacturer of records uses Sarco Thermotons on plating tanks.

1. At the cost of a good steam trap, the Sarco No. 87 Thermoton takes care of condensation removal and at the same time provides approximate temperature control of steam heated tanks, kettles or other small equipment. For the first time it has brought automatic control within the reach of small plating shops where it is used for all heated tanks, including washing and rinsing.

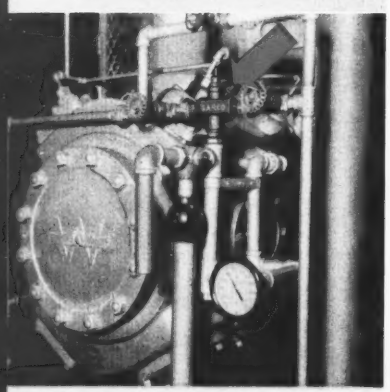
Catalog No. 550

A textile plant tried one TR-21 Temperature Regulator and now has four.

2. Sarco type TR-21 self-operated temperature regulators are standard equipment on water and oil heaters, for all types of process work such as cooking, evaporating, drying, or degreasing; also for cooling controls and air conditioning.

Powerful liquid expansion systems provide gentle throttling control. Valves are packless — no stuffing boxes to leak or stick.

Catalog No. 600



The TR–40 Cooling Control saved 75,000 cu. ft. of water a year in a chemical plant.

3. If you are interested in saving up to 50% of the cooling water used on air compressors, condensers, stills, internal combustion engines, or degreasers, you will want to investigate Sarco type TR-40 cooling control.

A low cost, rigid stem type, it is easy to install, prevents over-or under-cooling, and saves on lubricating oil as well as water.

Catalog No. 700 describes four different types in sizes from ⅜" to 8"

80% of all industrial temperature control problems can be solved by a simple self-operated Sarco Regulator or an inexpensive "on and off" Sarco Electric Control.

SARCO

Saves Steam

SARCO COMPANY, INC., 475 FIFTH AVENUE, NEW YORK

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, 9

Represented in Principal Cities

Man the Pumps!

First we require a device to spin liquid at high speed...
Now we need a shaft to support and turn the impeller...
Now we need a "straw" through which liquid can be sucked...
We contain and direct the spinning liquid with a casing...
AIR POCKET
ALLOWED BY DOWN-SLOPING PIPE
AIR POCKET
ALLOWED BY TAPERED REDUCER
Knock a country's pumps out —
THE WEIGHT OF PIPING CAN EASILY BURST A PUMP!

When you do need new pumps—take a good look at the extra efficiency, ruggedness and long life built into Allis-Chalmers centrifugal pumps . . . the famous "Electrifugal" — and all types of pumps for every purpose. In the meantime, let "Handbook for Wartime Care of Centrifugal Pumps" help you make present pumps *last!*——→

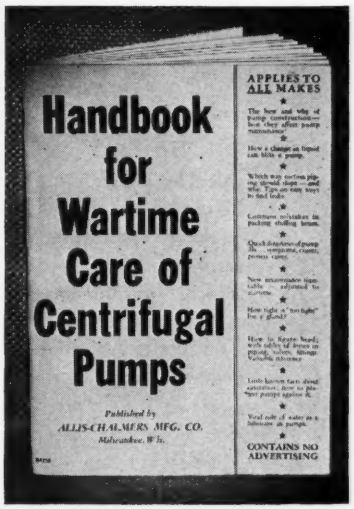
ALLIS-CHALMERS
MILWAUKEE

WE WORK FOR VICTORY — WE PLAN FOR PEACE

—TODAY THAT MEANS: "MAKE 'EM LAST!" . . AND HERE'S ALLIS-CHALMERS' GREAT NEW CENTRIFUGAL PUMP MAINTENANCE GUIDE TO HELP YOU DO IT!

HERE'S THE REASON most pre-war pump maintenance literature is seriously out of date today: *pumps that used to work 1800 hours a year are now working 8700 hours a year.*

Another reason: America can no longer *afford* unnecessary pump failures or lowered efficiency!



In Allis-Chalmers' new centrifugal pump maintenance book a pump is *built* . . . giving fresh, new insight into the kind of care a pump needs in *wartime.*

Tear out the order form below and send in today for *your* free copy!

ALLIS-CHALMERS MFG. CO.
Milwaukee, Wisconsin

Gentlemen:

Yes, I would like to receive *free of charge* a copy of your "Handbook for Wartime Care of Centrifugal Pumps".

(Name)

(Title)

(Company)

(Street Address)

(City and State)

A-1576-7

The TERRY W

GRABBING A5

This 1500 KW Terry unit is equipped with the Terry solid one piece wheel. The buckets, as shown above, are milled from the solid metal. There are no parts to work loose. • • • The blades have large clearances and are further protected by the projecting rims at the sides of the wheel. These rims would take without damage any rubbing that might occur if the radial clearance became reduced. • • • End play can do no damage to the blading as the side clearance is very large (about one inch). There is no end thrust since the steam enters and leaves the wheel in a direction at right angles to the shaft. • • • Such sturdy rotor construction makes for long life and low maintenance.

The quick starting Terry unit is re alternator unit, shown ment's right, is installed in a eam at completed West Coast omes u station. Normally, the stati ity in iliaries are supplied with strenuo power from a house servic on bla former. During periods overno system frequency or in s of th failure of the house serv sed in auxiliary load is taken st on the Terry unit. will br

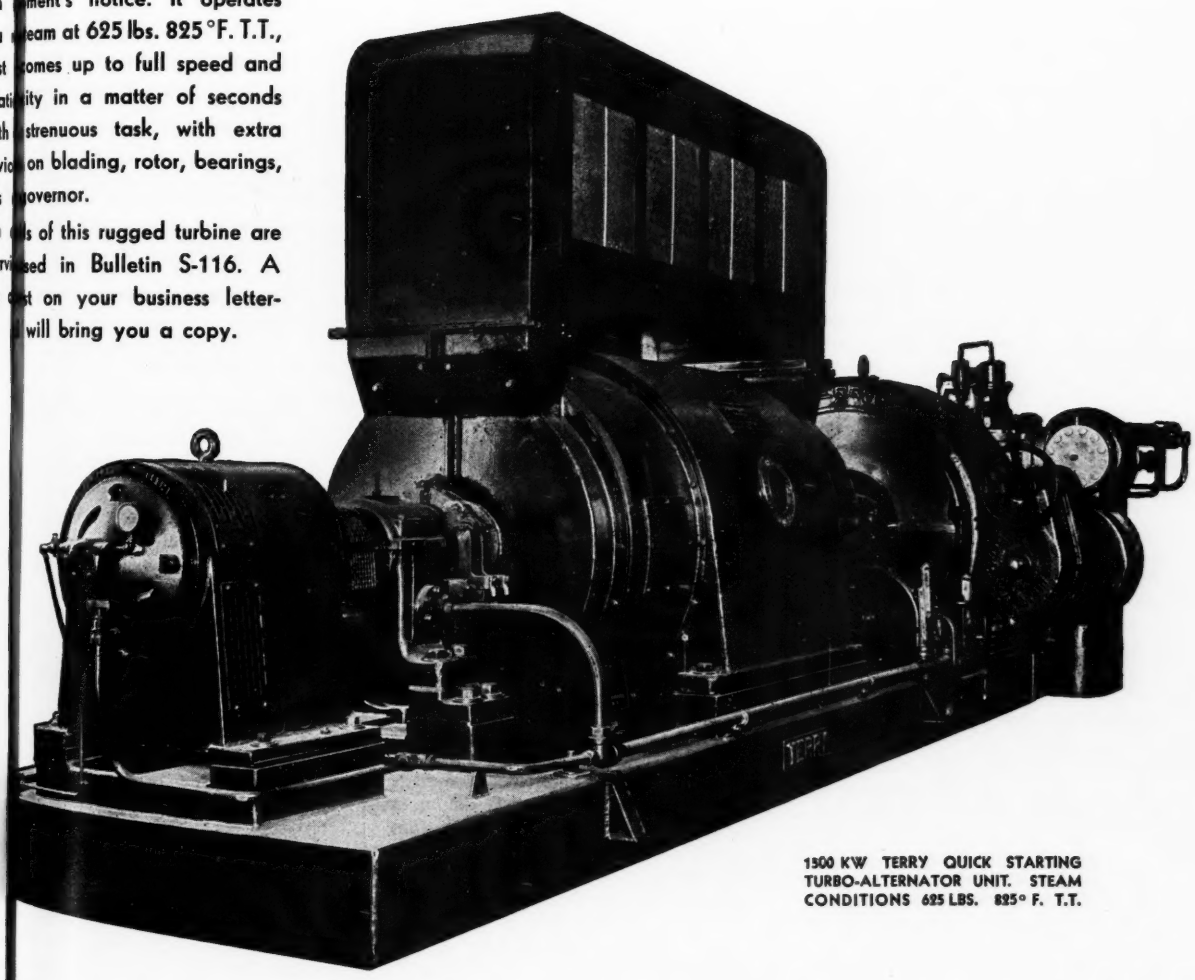
THE TERRY STEAM TURBINE CO. T

Wheel Turbine

500 KW LOAD ON A MOMENT'S NOTICE!

Terry nit is ready to take over on own ment's notice. It operates n a eam at 625 lbs. 825°F. T.T., Coast omes up to full speed and e stati ity in a matter of seconds with strenuous task, with extra servic on blading, rotor, bearings, iods governor.

in s of this rugged turbine are serv sed in Bulletin S-116. A ken st on your business letter- will bring you a copy.



1500 KW TERRY QUICK STARTING TURBO-ALTERNATOR UNIT. STEAM CONDITIONS 625 LBS. 825° F. T.T.

T-1150

TERRY SQUARE - HARTFORD, CONN.

Scovill Tube New

Vol. 1 SCOVILL MANUFACTURING COMPANY, Waterbury, Conn. No

Common Causes of Corrosion In Condenser and Heat Exchanger Tube

Types of Tube Corrosion

Film Formation

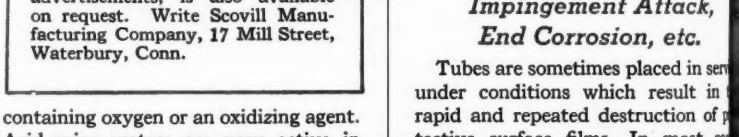
The corrosion resistance of condenser and heat exchanger tubing depends upon the nature of the films that form on the wall of the tube. The ability of copper and its alloys to form protective films on their surfaces under varying conditions of service explains their inherently excellent corrosion resistant properties. In some cases, this film may be formed simply as a result of oxidation. More often, however, the film is composed of an insoluble salt or a combination of insoluble compounds. In order to be protective, the film must be adherent, continuous and relatively insoluble. In general, thin films are more likely to have the more protective properties. It is evident that the formation of soluble salts at the metal surface will lead to continued corrosion. Likewise, coatings which are porous, loosely adherent, friable or easily broken, or discontinuous, offer little protection to the metal and may actually accelerate corrosion. Tubes which operate under service conditions which allow the formation of a uniform protective film will corrode only slowly and uniformly and will have a normal trouble-free service life. Under such conditions, tubes will last for periods in excess of 20 years. On the other hand, if operating conditions are not favorable to the formation of a protective coating, corrosion of one of the following types may be experienced.

Accelerated Uniform Corrosion

Tubes which are placed in service under conditions which result in corrosion at the tube surface with the formation of soluble salts only, will undergo a uniform thinning of the tube wall. The rate of such corrosion will depend upon the corroding medium, velocity of flow, temperature and other rate factors. Corrosion of this kind is often experienced in acid solutions, particularly with oxidizing acids or acid solutions containing oxygen or an oxidizing agent. Acid mine waters are very active in promoting corrosion of this type; also waters carrying a high carbon dioxide and oxygen content promote action of this kind. In addition to acids, solutions which have a definite solvent action on the products of corrosion of copper alloys, such as solutions containing ammonium hydroxide or cyanides, would behave similarly. Photographs of tube sections which illustrate various types of tube corrosion are shown on these pages. These photographs, reproduced in black and white from original four-color plates, bring out clearly the actual condition of the samples. The uniform thinning of the outside surface of a heat exchanger tube is illustrated in one of the photographs marked 1A and 1B.

"Service in Manuals" Designed for Scovill Customers Now Freely Available to All Wartime Tube Users

The "service in manuals" begun by Scovill years ago to assist customers in choice of alloys to fit specific corrosion and installation conditions, is now proving useful to many wartime firms faced with increasing need to conserve scarce tube metal. You may find in Scovill's "Condenser Tube Booklet" just the information you need — diagrams, formulae, lists of alloys — to make your condenser tubes serve you better and longer. A reprint of the article on this page, 4th in Scovill's continuing series of informative advertisements, is also available on request. Write Scovill Manufacturing Company, 17 Mill Street, Waterbury, Conn.

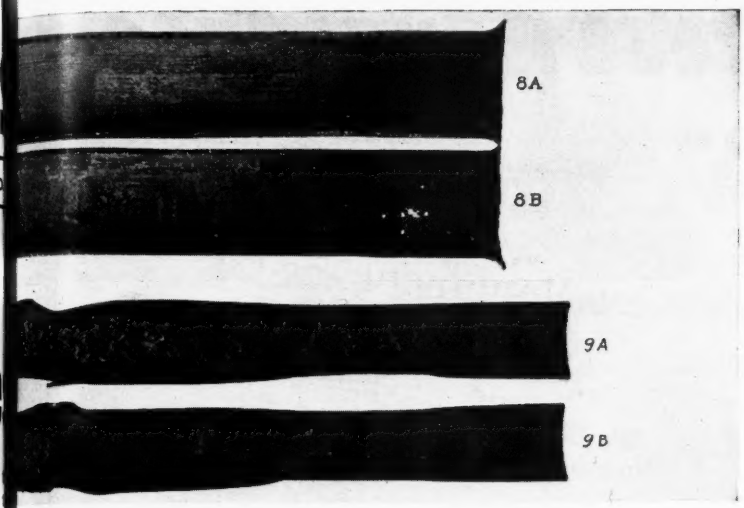


1A 1B

A comparison of the diameter of tube end which was protected by tube sheet (at the right of the sect in 1A) and that of the tube beyond section gives some indication of marked uniform corrosion of the t by the circulating medium. In 1B cross-sectioned view of the same t shows the difference in tube wall thi ness between the end within the t sheet (approximately the original thi ness of the tube) and the corroded tion beyond the tube sheet. Corros of this tube was caused by condens containing dissolved gases (Carb Dioxide, Oxygen, Ammonia, etc.); i to be noted that no appreciable co sion product has accumulated at outside tube surface.

Impingement Attack, End Corrosion, etc.

Tubes are sometimes placed in serv under conditions which result in rapid and repeated destruction of p tective surface films. In most ca action of this kind occurs at or near inlet end of the tubes and is variou described as "impingement attack, e corrosion, etc." There are usually c tain localized areas in a unit or sectio of a unit where failures from this cau predominate. The destruction of pr tective films at such localized areas due to a relatively high velocity of t circulating medium, together with turbulent condition and the action entrained or separated air. The attac is one of combined erosion-corrosion erosion removing the scale or protecti coating and subsequent corrosion of sus exposed metal surfaces. Occasionall erosion-corrosion may extend along t whole tube length. Combined erosio

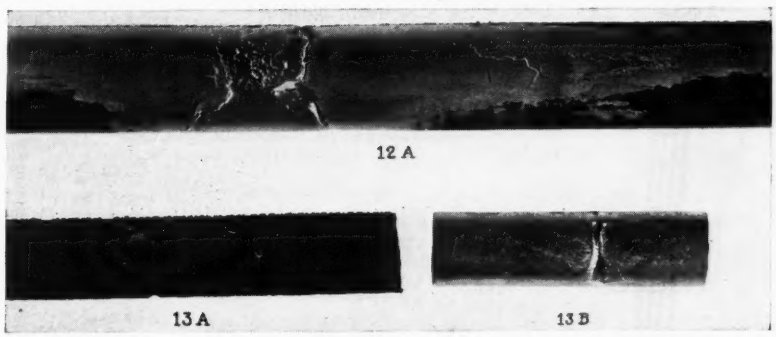


rosion of tube surfaces may also ur when the circulating medium car- in suspension appreciable amounts an abrasive material such as sand. inlet piece of tubing which has been tioned and opened up is shown in otographs 8A and 8B. Erosion-cor- ion of the inlet end of this sample has n very severe as shown by a very ghened surface condition and tube ll perforation approximately 1" from belled end of 8B. Beyond the first inches from the inlet end, the tube ws no severe corrosion. The two tions of a tube in photographs 9A and show an irregularly roughened inside face over their whole length due to neral erosion-corrosion of the metal.

Concentration Cell Action

Many cases of localized corrosion and ure of condenser and heat exchanger es are due to differential aeration or ncentration cells which form at the tal surface under certain service con- ions. A break in an otherwise satis- tory protective film may initiate such ion. Porous coatings over the metal face sometimes contribute to this e of corrosion. Cracks, crevices or er small openings at baffle or support tes where liquids may seep and be- me trapped are always a potential rce of trouble in this respect. A simi- type of corrosion may take place tween strained and unstrained metal as although corrosion from this cause relatively rare. Concentration cell ion is electro chemical in character d is due to potential differences between surface areas where a difference exists in the concentration of salts, ions or gases in the circulating medium. Two very good examples of concentration cell action are shown in photographs 12A and 13A and B. The outside surface of the tube section shown in 12A has a very badly corroded area which resulted in failure of the tube; corrosion and failure occurred at a baffle or support plate and was evidently due to concentration cell action between the area of the tube shielded by the baffle and adjacent areas. This tube was covered with a black scale over most of its surface, similar to that which is shown near the bottom at each end of the section, but this deposit was partially removed in order to show more clearly the corrosive action at the baffle area. The sections shown in 13A and B are parts of the same tube, 13A being an uncleaned piece just as it was originally removed from the unit and 13B a section with the scale removed. Both of these pieces have a deep circumferential groove at the outside surface, resulting from concentration cell action at baffle or support plates; corrosion in this case may have been due to a building up of iron rust or other corrosion product at the tube surface adjacent to the baffles or it may have been caused by seepage and trapping of liquid between the tube and baffles. "Water line" corrosion is a very excellent example of corrosion of the "concentration cell" type.

Additional types of corrosion will be discussed in the next issue of "Tube News".



Limitation order L-154 issued by the OPM. This order limits the use of non-ferrous condenser tubes in land power stations to Muntz metal for fresh water plants, and Admiralty metal for salt water plants. No non-ferrous metals containing more copper and more tin than these two are permitted by the order.

A 3-Way Service for Your Firm

The services which Scovill offers to its customers, and to every wartime user of Condenser and Heat Exchanger tubes, are not limited to the "Service in Manuals" described above. Scovill's "Service in Men" places at your disposal the advice and consultation of men with years of experience in practical tube problems; while Scovill's "Service in Metals" offers you complete laboratory and production facilities, available as national needs permit.

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

"The Greatest Advantage o

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St. Marys, O.

January 4, 1942

Iron Fireman Manufacturing Co.
Cleveland, Ohio

Gentlemen:

We wish to tell you how pleased we are with our installation of the Iron Fireman Pneumatic Spreader Stoker. We find it ideally suited for our requirements. Formerly we were using several small boilers with over-feed type stokers and were unable to keep our steam pressure to the desired level. The installation of one large boiler and the spreader type stoker has solved our troubles. Since we develop steam for processing purposes only, we do not have elaborate instruments and cannot give you a definite statement as to the increased output of steam, but our conservative opinion is that it is somewhere between seventy and eighty per cent increase.

There is a definite saving in coal costs as we have been able to use considerably cheaper coal as it was necessary to humor our former equipment with a prepared size coal. We have likewise saved considerable tonnage due to better combustion and consuming a far greater amount of the volatile matter. Further, the stoker is a pleasure for our personnel to handle as it has reduced manual effort to the minimum.

However, the greatest advantage is in its extreme flexibility. Our primary use for steam is for processing in four unrelated departments. The demand for steam is very unpredictable. Frequently extreme peaks are imposed upon the boiler with the demand falling off just as rapidly. This is due in part to our dye house, wherein we operate eight dye vats. Each one contains approximately 1,000 gallons of water which must be brought to the boil in a definite period of time according to formula. Since there is no regularity in the demands of a dye house, the boiler equipment must be able to meet the demand peaks when several of the various dye vats are placed on a line simultaneously. As a consequence the stokers must be of a nature to meet these excessive peaks at frequent intervals and be able to decelerate just as rapidly if such a term can be applied to boilers. We find that in spite of the peaks and subsequent falling off that we can hold our steam pressure to within a variance of two pounds. We consider this superb performance.

Yours very truly,
ST. MARYS WOOLEN MFG. CO.

Phil. Herzing

Phil. Herzing, President

PH/ar

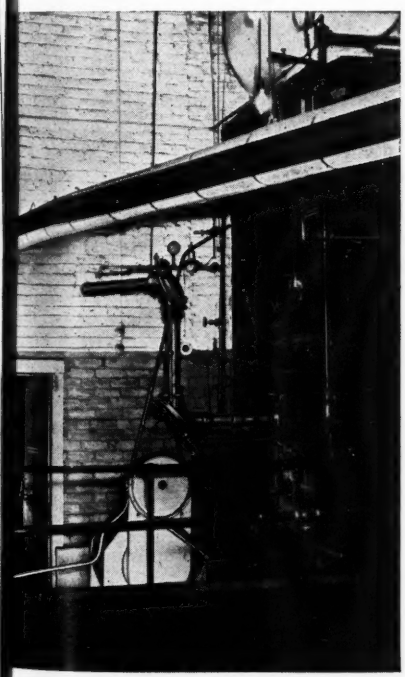
IRON FIREMAN
THE IRON FIREMAN
Automatic Coal Stoker

...our IRON FIREMAN Stoker ...is its Extreme Flexibility"

"Steam pressure is kept at the desired level . . . . . there is a definite saving in coal costs"

Phil Herzing, Pres.

PHIL HERZING
President, St. Marys Woolen Manufacturing Co., manufacturers of the world famous St. Marys blankets.



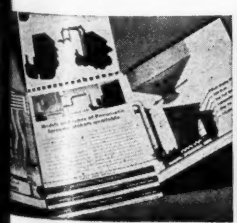
...he Iron Fireman Pneumatic Spreader stoker ...s reduced manual effort to the minimum at St. Mary's Woolen Manufacturing Co.

IT'S performance like this that has won thousands of friends for Iron Fireman. And automatic coal firing, as pioneered and developed by Iron Fireman, has come to the rescue of plants that, due to fuel shortages, must convert from other fuels to coal firing. Stokers are available for firing boilers up to 1000 horsepower and larger.

By government request, Iron Fireman is making more commercial and industrial stokers than ever before. The thousands who will convert to Iron Fireman firing will find these characteristic advantages: (1) Ample reserve for excessive loads; (2) flexibility for sudden steam demands; (3) increased boiler efficiency with clean combustion; (4) uniform pressures or temperatures; (5) smoke and waste reduced to a minimum; (6) fuel savings in dollars and tonnage; (7) ability to burn local coals and help win the battle of production.

If you are faced with fuel changes or increased steam demands, let us tell you how you can buy an Iron Fireman. Write, wire or telephone Iron Fireman Manufacturing Company, Cleveland, Ohio.

Factories in Portland, Oregon; Cleveland, O.; Toronto, Canada.



FREE BOOK on Pneumatic Spreader Firing

Contains full descriptions, capacities, operating data, etc., with layouts and photos of 10 actual installations. Sent free, on request. Write to Iron Fireman Mfg. Co., 3515 W. 106th Street, Cleveland, Ohio.

ELECTRONIC Instruments in the industrial plants of tomorrow will supply that life-blood of change and improvement which makes for scientific progress and commercial success.

To anticipate the exacting demand of industry's future instrumentation, Brown and Minneapolis-Honeywell engineers have assumed the obligation of leadership in pioneering new developments for the measurement and control of industrial processes.

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HOW TO BANISH THIS

Power wasting ghost!

Scale, the boiler room ghost, grows until boiler efficiency is impaired and shutdowns for cleaning and expensive repairs can no longer be avoided. The way to completely eliminate scale is to condition your boiler water in accordance with the most approved methods.

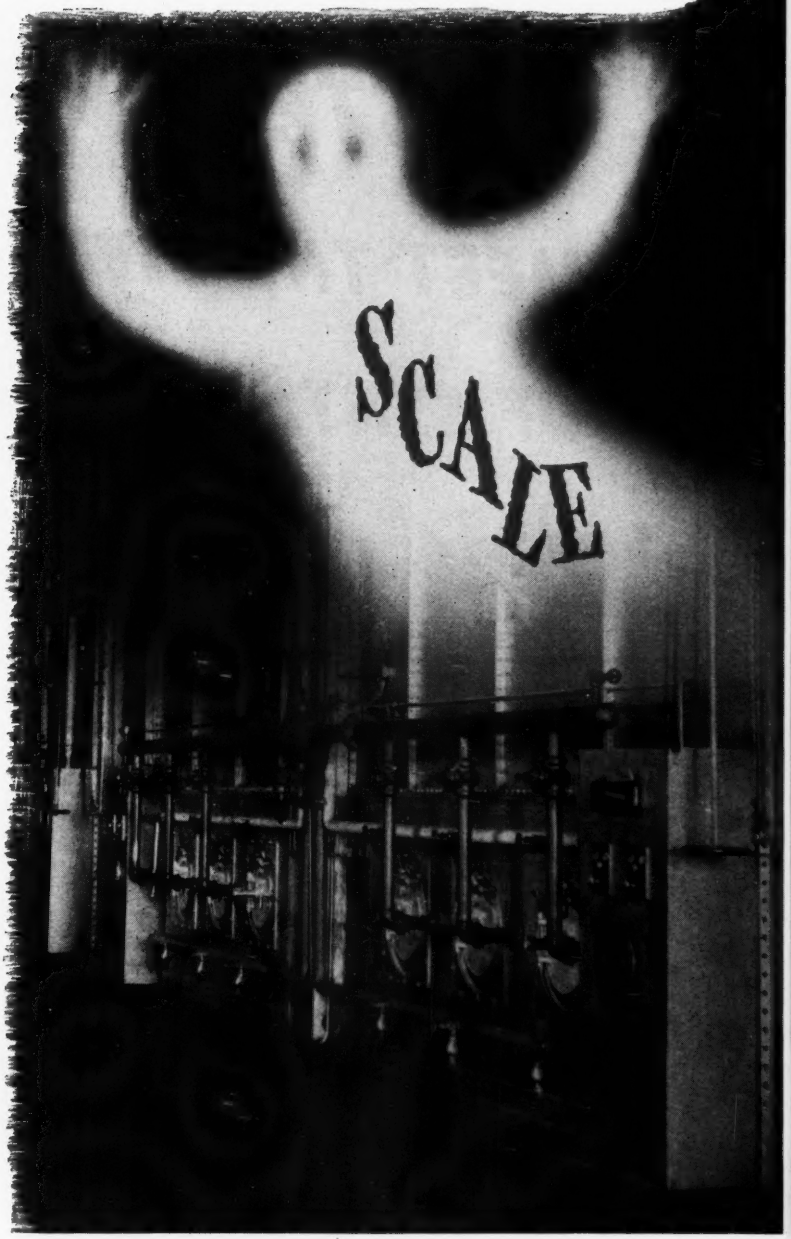
The Dearborn Way of Water Conditioning Assures High Efficiency

Dearborn Service is designed to fit the operating conditions prevailing in your own plant. The recommended treatment for you is balanced to give full protection against all of the conditions revealed by the water analysis and plant survey.

Boilers, Like Men, Have to Be Fed Well to Win

Dearborn Engineer is right at hand to work with you and to see to it that your boiler feedwater is conditioned to deliver full steaming efficiency. He continues to call regularly to insure maintenance of the operating procedure he recommends. If you are not a user of Dearborn service, drop us a line . . . we'll arrange to see you.

Dearborn Chemical Company
Dept. F, 310 S. Michigan Ave.
Chicago, Illinois



Dearborn
TRADE MARK REGISTERED

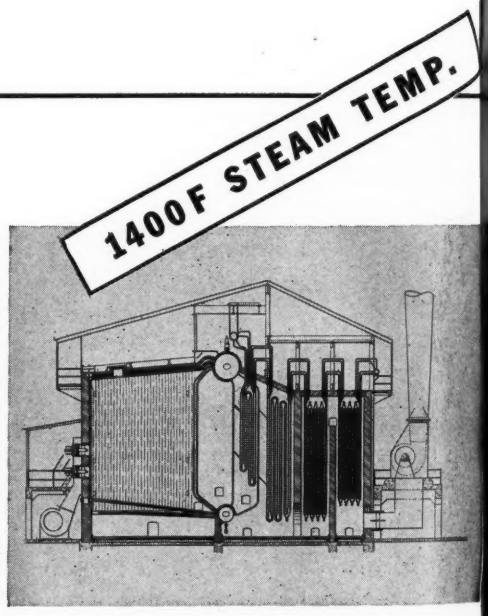
WATER TREATMENT AND ENGINEERING SERVICE

C-E STEAM GENERATING
MEET THE DIVERSIFIED STEAM
OF SYNTHETIC RUBBER PLANTS

How the diversity of C-E steam generating equipment is meeting the needs of the new synthetic rubber plants is illustrated in part by these three different types of units which are among those now under construction.

One is the new forced-circulation design recently introduced by C-E. One is natural circulation, employing the standardized VU Unit which has its own special advantages. One is a separately-fired superheater especially designed to produce steam at 1400 F. Taken collectively they represent three types of firing—pulverized coal, gas and oil.

It is natural for the synthetic rubber plants with their new and peculiar problems to turn to C-E where they find the most complete line of boilers available anywhere; the specialized knowledge required to design superheaters to produce steam at 1400 F; every size, and type of fuel-burning equipment; and the engineering skill which has been responsible for many of the leading achievements in the field of steam generation.



Specially designed unit to produce steam at 1400 F. A water-cooled furnace precedes the four bank superheater.

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

COMBUSTION

NGNITS

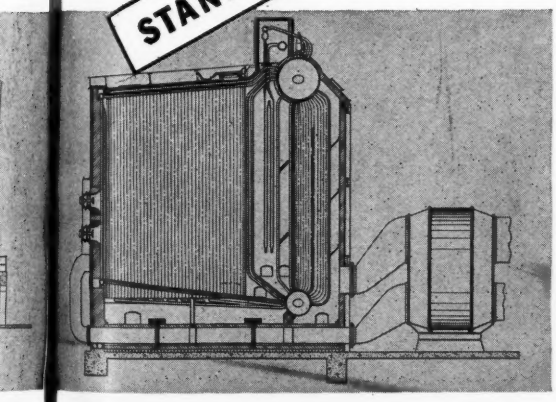
AMEEDS

TS

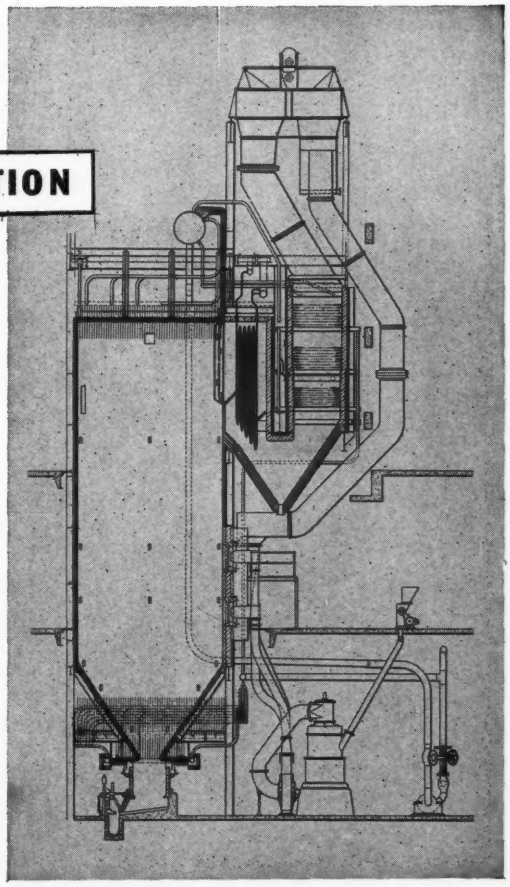
P.

FORCED CIRCULATION

STANDARD VU DESIGN



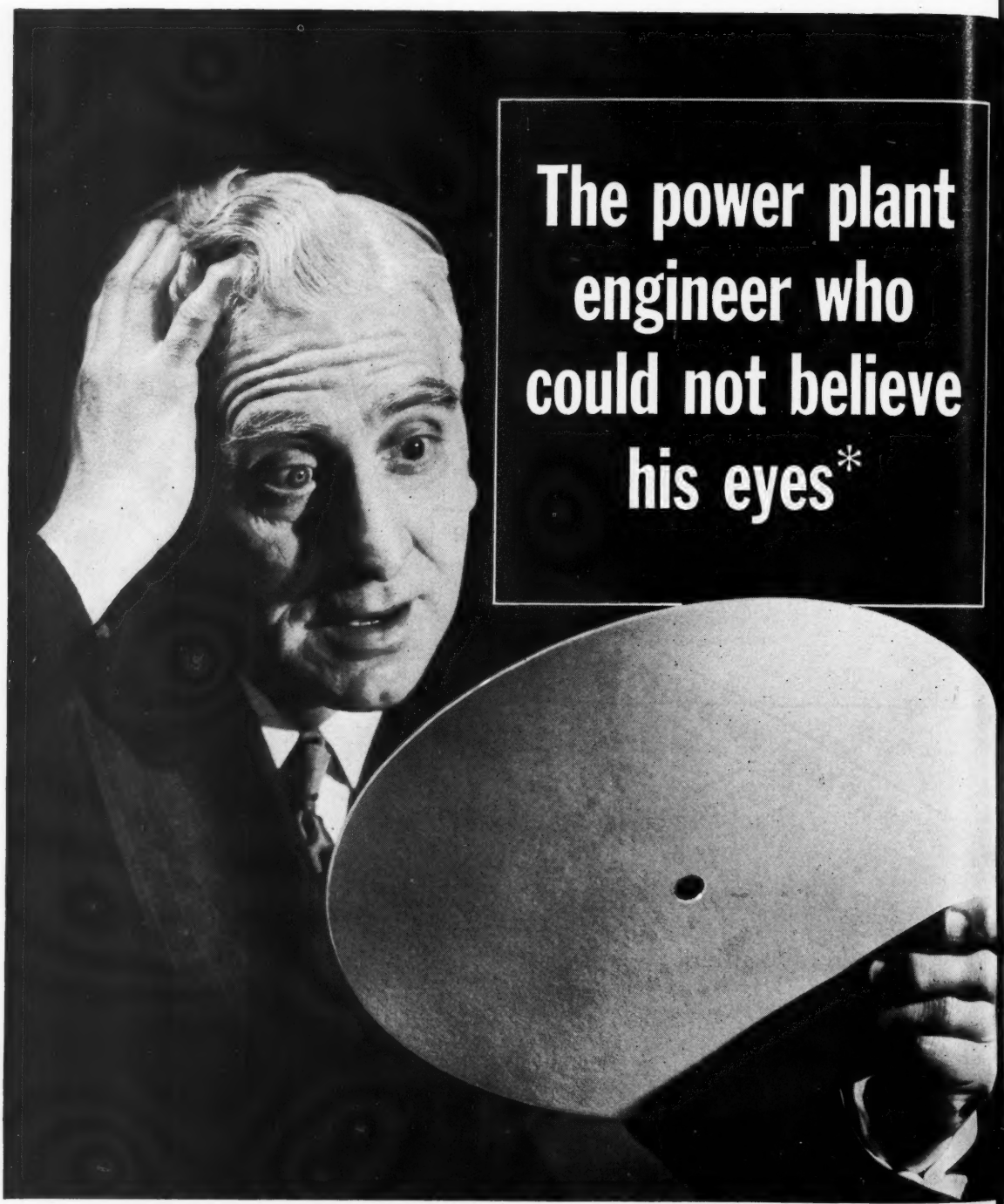
C-E Steam Generator, Type VU. Capacity—300,000 lb steam per hr. Design Pressure—800 psi. Total Steam Temperature—750 F.



C-E Controlled, Forced-circulation Boiler. Capacity—350,000 lb of steam per hr. Design Pressure—800 psi. Total Steam Temperature—750 F.

IR HEATE BUSTION ENGINEERING COMPANY, INC., 200 MADISON AVENUE, NEW YORK, N. Y. • CANADA: COMBUSTION ENGINEERING CORPORATION LTD., MONTREAL

ENGINEERING



Things you should know about Hagan Control

Hagan engineers were the first to successfully introduce automatic combustion control.

And through 25 years of experience with this system they have been first to introduce many notable improvements since accepted as standard.

This fact alone is sufficient to justify an investment in Hagan. Regardless of other means employed, Hagan Control, by adjusting all auxiliaries for maximum output, will positively assure the maximum of steam from every pound of fuel.

It was not his fault. . . It was his first experience with Hagan Control

We would not think of telling you where this incident occurred. But here is the story just as we took it from a Hagan engineer's call-report:

'A day or two after we put the pressure-reducing station in service, one of our men happened to be out in the turbine room and saw one of the turbine room engineers busily engaged in taking a pressure recorder apart. Our man asked him what he was doing and the chief engineer told him the gauge was stuck and he was fixing it. Actually what happened was that the steam pressure was held so closely by the Hagan Control that the engineer had obtained this false impression. There was nothing wrong with the gauge; it was only the fact that they had been used to seeing the pressure *vary all over the lot,* with previous hand operation of the old boiler. Now that the steam was coming from the new high-pressure boiler and through the Hagan Pressure-Reducing Valve, the recorder was drawing a perfect circle."

Experiences similar to this are becoming more and more common as new high-pressure boilers are being operated in conjunction with old, low-pressure boilers.

NOTE: When your new boilers go in service be sure that the pressure-reducing station and desuperheater are controlled by time-proven Hagan pressure-reducing equipment. Hagan Automatic Pressure-Reducing Systems are available to meet any operating conditions. Full particulars on request.

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH, PA.

HAGAN

Automatic COMBUSTION CONTROL

The pioneer . . . and still the leader

Count the specific advantages Hagan superior engineering offers:

1. Simplicity of operation.
2. Ruggedness of equipment.
3. Sensitivity to small load changes.
4. Accuracy of adjustment for small variations.
5. Speed of movement, with stability, throughout operating range.
6. Flexibility in meeting individual plant conditions.
7. Ease of installation.

For further evidence of Hagan leadership look to the thousands of installations throughout industrial America which year in and year out perform with unqualified efficiency.

An investment to meet today's needs for increased steam capacity which will pay rich dividends in the tomorrows to follow.

HAGAN
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ARMSTRONG Forged Steel STEAM TRAPS

Offering EXTRA Protection for any plant!

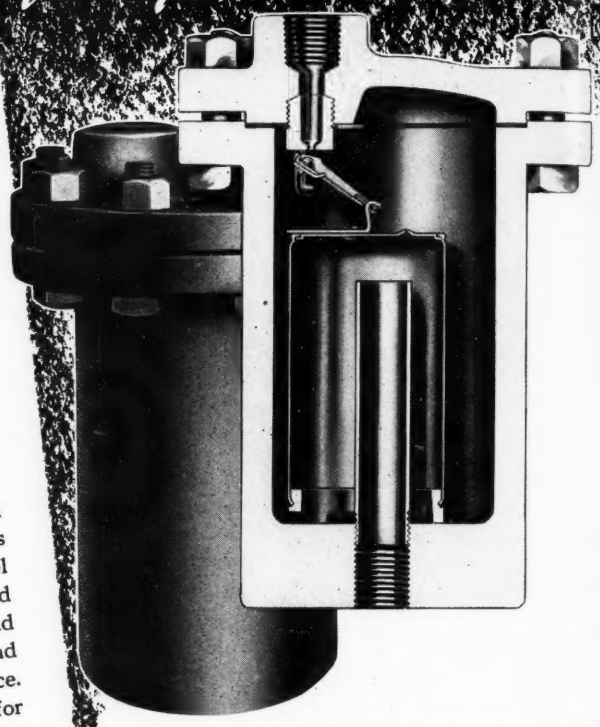
TODAY the dependability of Armstrong Forged Steel Steam Traps is enabling many engineers to operate their plants with a minimum of attention paid to maintenance. When correctly installed these traps provide *positive protection* of valves and equipment against condensate as well as carryover from the boiler.

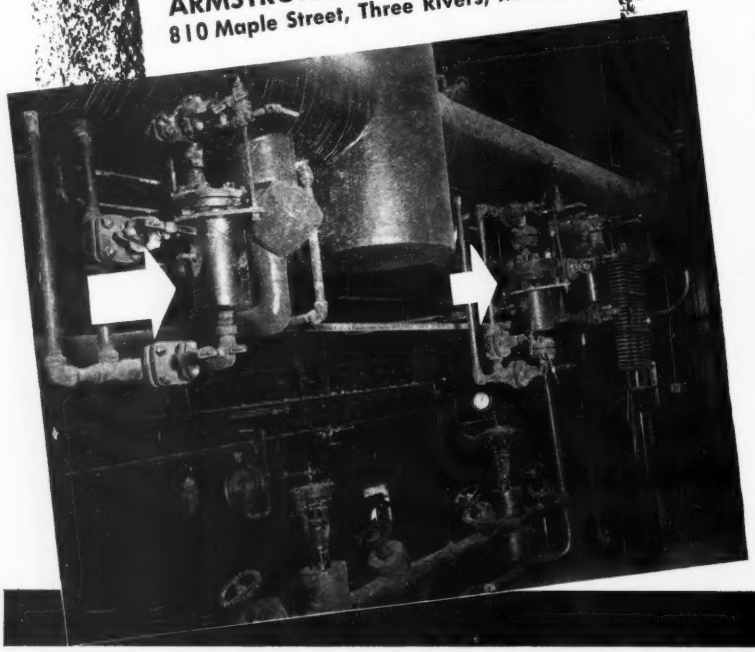
In the Armstrong Forged Steel Traps the use of special die forgings for cap and body plus special steel construction for internal trim . . . and special chrome alloy for valve and seat . . . mean extra protection and long lasting dependable performance.

Armstrong Forged Steel Traps for all pressures and any capacity. Let Armstrong help you on your own specific trapping problems. Write today, no obligation.

ARMSTRONG MACHINE WORKS
810 Maple Street, Three Rivers, Michigan

The last word in Safety for high pressure Plants





1. ECONOMICAL TO USE — Wide choice of sizes starting with small ½ inch. Built for either screwed or flanged connections.

2. FOR ANY PRESSURE — Built for 400, 600, 900, 1500 and 2400 lbs. pressure.

3. FOR ANY CAPACITY — Forged steel construction available for both plain traps and super-capacity compound traps.

4. UNSURPASSED QUALITY — Cap and Body 79,000 lb. tensile strength or higher. Heat treated valves.

5. COMPLETE ENGINEERING DATA— Printed information will be sent to you on request and without obligation. Complete capacity curves . . . trap specification and dimension sheets . . . installation diagrams.

ARMSTRONG · "INVERTED BUCKET" STEAM TRAP

Safer Boiler Operation
Easier Maintenance with

SPECIFY! ERNST FITTINGS

Fig. 4
Standard Type—Offset Adjustable Inclined Gage Fittings

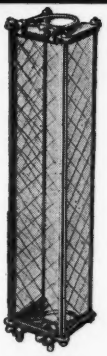


Fig. 9
Wire Glass "Better-C" Guards, All Sizes

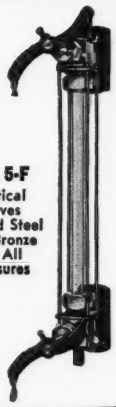


Fig. 5-F
Vertical Valves Forged Steel and Bronze for All Pressures

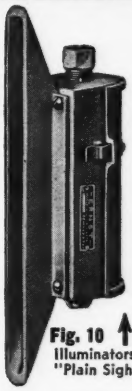


Fig. 10
Illuminators—"Plain Sight"

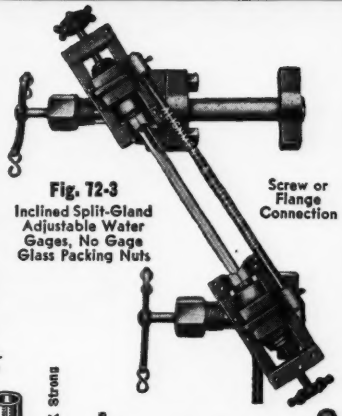


Fig. 72-3
Inclined Split-Gland Adjustable Water Gages, No Gage Glass Packing Nuts

Screw or Flange Connection

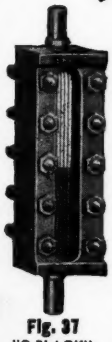


Fig. 37
"C-BLACK" Prismatic Flat Glass Inserts

Fig. 45
"C-Clear Thru" Flat Glass Inserts

Fig. 18 Fig. 19
FLAT GLASSES

GAGE GLASS GASKETS

Standard Pattern Gaskets — High Pressure — **Fig. 22** — Non-hardening and Non-softening SERIES 750

Send for Gasket Tag showing sizes

GASKETS THAT WILL FIT EXACTLY

Lip-mold Pattern — **Fig. 21** — Expansion Type Gasket

Fig. 12 Fig. 23 Fig. 14

LEAKLESS COCKS

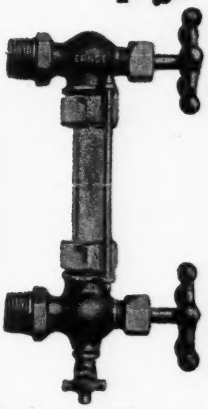
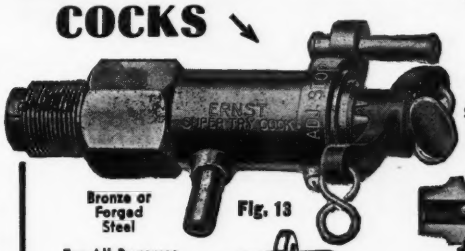


Fig. L-150
Steam Metal Bronze Gage for pressures up to 150 pounds



Bronze or Forged Steel

Fig. 13

For All Pressures

Fig. 16

For Pressures Up to 250 lb. — This Ernst DCP (Double Chain Pull) Try Cock insures a tight shut off. Order in sets of 3 to complete one water column.

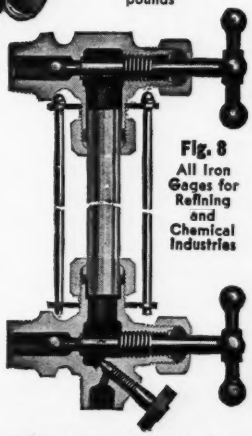


Fig. 8
All Iron Gages for Refining and Chemical Industries

Fig. 18

SIGHT GLASSES for all types OIL CUPS and LUBRICATORS

Fig. 17

SIGHT FLOW INDICATORS for insertion into Pipe lines —All Sizes—

NAVY GAGE

Fig. N-10

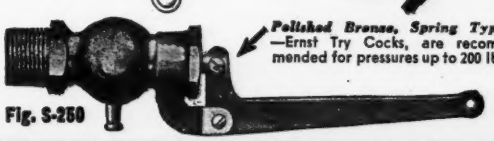
We also manufacture..

SAFETY ALARM WATER COLUMNS

FOR ALL TYPES OF BOILERS COMPLETE WITH TRIM

DELIVERIES FROM STOCK
ORDER BY FIG. NUMBERS

SEND FOR COMPLETE CATALOG and State Your Requirements



Polished Bronze, Spring Type —Ernst Try Cocks, are recommended for pressures up to 200 lb.

Fig. S-250

ERNST WATER COLUMN & GAGE CO.
LIVINGSTON, N. J. *Manufacturing For More Than 35 Years* Phone: Livingston 6-0276

PUT NEW POWER INTO THE OLD WAR HORSE

Those "war horses" have been pulling hard now for more than a year . . . for the seventeen months of steady, all-out production since Pearl Harbor.

Already many Diesels are beginning to show signs of strain. Longer hours of operation, less frequent overhauls, fewer replacements—all have increased the hazard of breakdown a hundredfold.

There's one way, even at this late hour, to help keep your Diesel geared for steady, smooth, efficient action . . . *Make sure that you're servicing it with Precision-Perfect Lubricants!*

Cities Service D-C 500 Series Oils for high-speed automotive type Diesels . . . and Pacemaker or Penn-Pacemaker Series oils for stationary type Diesels . . . are designed to meet the most exacting demands of wartime operation.

If you want to be sure you're getting the most out of your Diesels, let a Cities Service engineer study your particular operation. No obligation, of course. Simply get in touch with your nearest Cities Service office today.

For a helpful booklet on "Diesel Engine Lubrication," write to Room 1375, Sixty Wall Tower, New York, N. Y. Free to owners of Diesel engines and their personnel.

ARMY E NAVY

MAUMELLE ORDNANCE WORKS
CITIES SERVICE DEFENSE CORPORATION

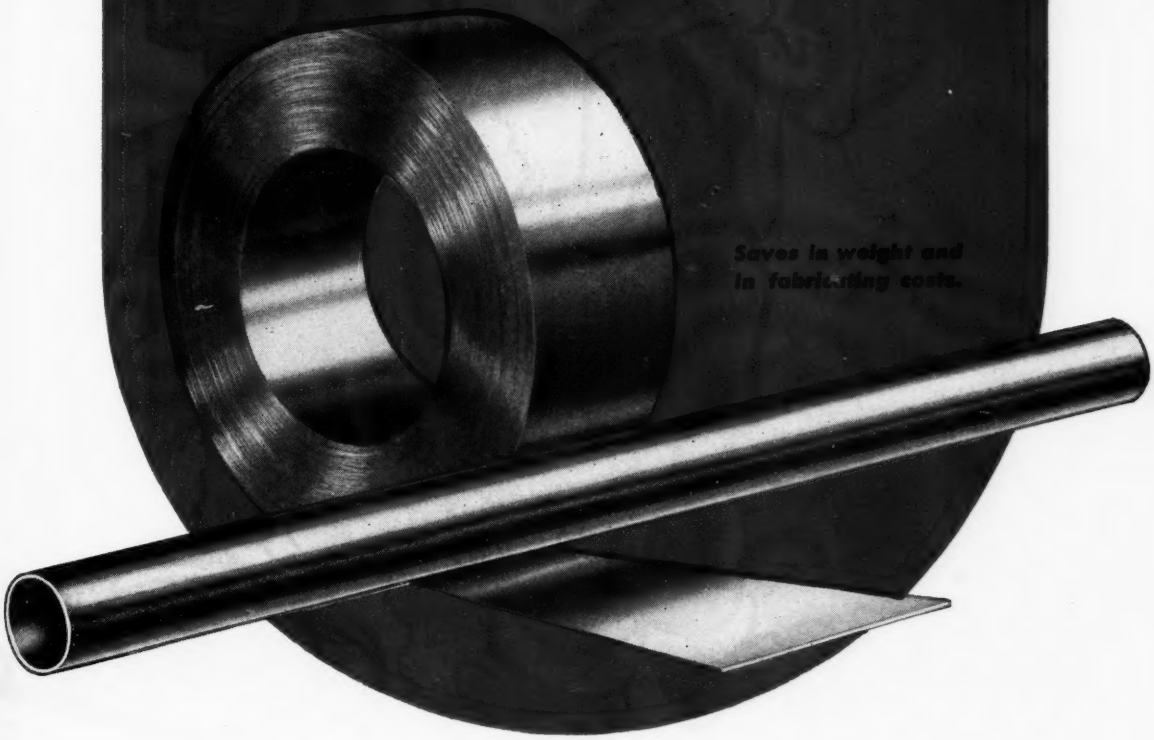
OIL IS AMMUNITION—USE IT WISELY!

CITIES SERVICE OIL COMPANY
NEW YORK · CHICAGO

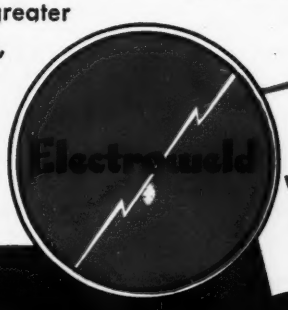
IN THE SOUTH
ARKANSAS FUEL OIL COMPANY
SHREVEPORT, LA.

Electroweld Tubing

Includes Strip Steel Accuracy and Precision Welding



ELECTROWELD TUBING is manufactured on the latest type and most modern tube mills, thus assuring uniform high qualities at all times. This outstanding product meets accurately your rigid requirements, but more than that, the specified qualities are duplicated in order after order, and shipment after shipment. The Electroweld manufacturing process permits the selection of accurately rolled strip steel which definitely meets your needs. And, with this uniform, high quality basic material you obtain maximum strength, greater safety, more uniform wall thickness, uniform diameters, and silver-bright, smooth finish. Remember, too, the exhaustive tests made during 1929 by the Bureau of Standards proved conclusively that the weld in tubing is as strong as the wall, and has the same quality as the steel with regard to strength and other physical properties. The tests included expanding, beading, flanging, and drawing. Electroweld Tubing is made in strict accordance with Government, A.S.M.E. and also A.S.T.M. specifications. Hence, where performance factors are VITAL be sure to investigate the benefits of Electroweld Tubing.



SIX ADVANTAGES

Uniform diameter • Uniform wall thickness • Uniform physical properties • Test-proven welds • Scale-free, silver-bright finish • Square cuts, minimum burr

Electroweld STEEL • • OIL CITY, PENNA.

A Division of TALON, INC.

Manufacturers of pressure and mechanical steel tubing

FOR CORROSIVE LOCATIONS. These oil-immersed combinations are made in two forms — for both corrosive and hazardous locations.

DUST-TIGHT COMBINATIONS. Available through NEMA size 5—these starters are for application in dusty locations

NEW HIGH-VOLTAGE COMBINATION. This provides split-cycle short-circuit protection and starting means for high-voltage motors.

GENERAL ELECTRIC

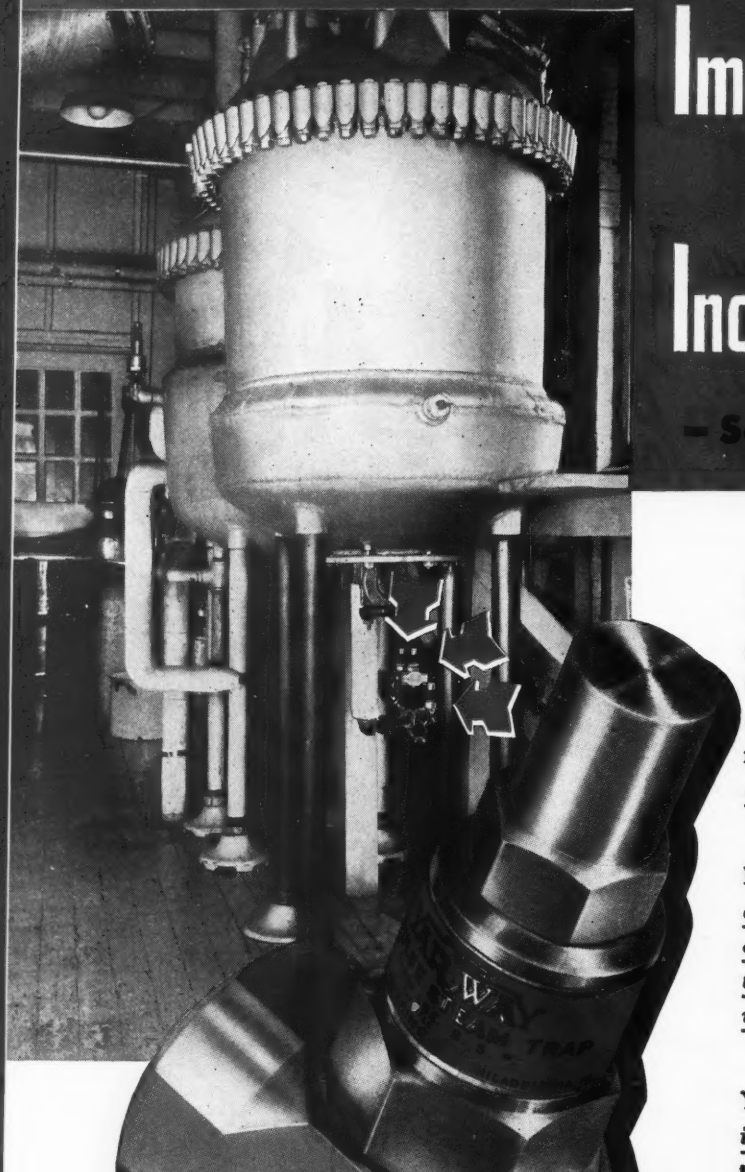
676-93C-8490

HEY BILL!
YOU'RE DOUBLING YOUR WORK WHEN YOU INSTALL CONTROL THAT WAY!
EVER HEAR OF G-E COMBINATION MOTOR STARTERS?
BY using G-E combination starters, you can cut the time required to install motor control by 50 per cent. That's because "combinations" combine two controls—a motor-circuit switch (with short-circuit protection) and a magnetic starter—in one, compact, easy-to-mount unit.
But that isn't all—combination starters save critical material by eliminating unnecessary conduit; and they offer your operators better protection because the case door is interlocked with the safety switch.
Save man-hours and critical material by specifying General Electric combination starters. General Electric Company, Schenectady, N. Y.
WATERTIGHT COMBINATIONS For outdoor application and for installation in damp locations.
FOR HAZARDOUS LOCATIONS Enclosed in a high-strength, alloy case, these starters are ideal for Class 1, Group D, locations.
FOR GENERAL-PURPOSE USE These combinations are for indoor applications where atmospheric conditions are normal.

MBINATION STARTERS FOR MOTORS FROM 1 TO 1000 HP

"YARWAY IMPULSE TRAPS Improved Heating and Increased Efficiency"

– Says G. W. Carnrick Co.



SINCE the first Yarway Impulse Traps were installed, the improved heating and increased efficiency obtained have induced the G. W. Carnrick Co., (makers of liver extracts and other compounds), to purchase no other make. Today, about *80 per cent of the traps in their plant are Yarways.*

You, too, can solve your trapping problem by standardizing on Yarways. They provide *quicker heating; greater sustained heating efficiency; lower installation and maintenance cost; fuel economy; saving in valuable floor space* due to their small size.

Then too, you can probably install new Yarways for *no more than the cost of repairing* the *old traps* in your plant. It is often the case.

See your Mill Supply Dealer—or write for Bulletin T-1737.

•

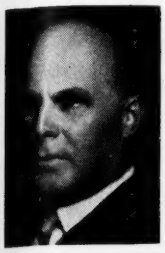
YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

Electric Power Supply

By CHARLES W. KELLOGG



UP TO April 1941 the largest non-coincident peak load then recorded on the electric facilities, both private and governmental, contributing to the public supply, was 31,500,000 kw. Today the corresponding figure is 36,900,000 kw., or over 15 per cent more. During these two years the installed electric generating capacity went from 42,000,000 kw. to 47,000,000 kw., the margin between capacity and peak being now therefore about the same as it was two years ago. As measured by government expenditures for defense or war, the last recorded month (February, 1943) showed $5,770,000,000 compared to $593,000,000 in February 1941, a tenfold increase.

The increased rate of aluminum production in the two-year period required about 1,600,000 kw.; increased output for electric steel and ferro alloys during the period required about 700,000 kw. additional; magnesium, synthetic rubber, high explosives, smokeless powder and other war requirements all took large amounts of power not needed before.

How has it been possible to take care of these huge war power requirements with the apparently moderate increases in maximum power load (of 15 per cent in two years) which the records shows to have occurred? The answer is principally in the substitution of war for peace activities. But it has also been effected by power pooling and by the change to Standard War Time, both being reflected in higher load factor.

By the time the war arrived in 1941, 80,000 circuit miles of transmission lines of 60,000 v. or higher had made a veritable network of electrical interconnections throughout all the populous areas, and especially industrial areas, of the nation. The Office of War Utilities (or its predecessors) has arranged for the establishment of some additional interconnections. It estimates that these have had the effect of reducing the combined maximum demand on the systems interconnected by a very substantial amount.

The Office of War Utilities obtained the enactment by Congress of Standard War Time, whereby it estimates peak loads have been reduced in the aggregate 1,000,000 kw.

Additional effective reduction of the magnitude of peak loads has resulted both from longer hours of use of manufacturing facilities through working two and three shifts in war plants and from the increase in the percentage of electricity going into the production of aluminum and into other such processes with essentially long hours of operation throughout the year. Up to last year the highest annual load factor ever recorded in the public electricity supply was 54.5 per cent. Last year, 1942, this jumped to 58.4 per cent. The actual output of 1942, if produced at the highest previously known annual load factor, would have required 2,660,000 kw. more generating capacity than was in fact needed on peak in that year. The increase in electric energy output, arising solely from higher load factor, and obtained therefore without a single kilowatt of increased demand on generating stations, amounted to 12.7 billion kilowatthours.

In the early stages of defense preparation, civilian activity was thought of as normal and war activity as something else that had to be taken on over and above normal. Viewed in retrospect it seems that the paradoxical difference between war requirements and total power requirements can be explained much more through the extent of substitution of war work for civilian activity than through the load factor considerations that have been mentioned.

It is frequently overlooked, in discussing the supply of power for industry, that in spite of all the efforts through the years by the utilities to sell their output to industry, about 33 per cent (in 1942) of the total industrial electric power supply was still made by manufacturers themselves for their own use.

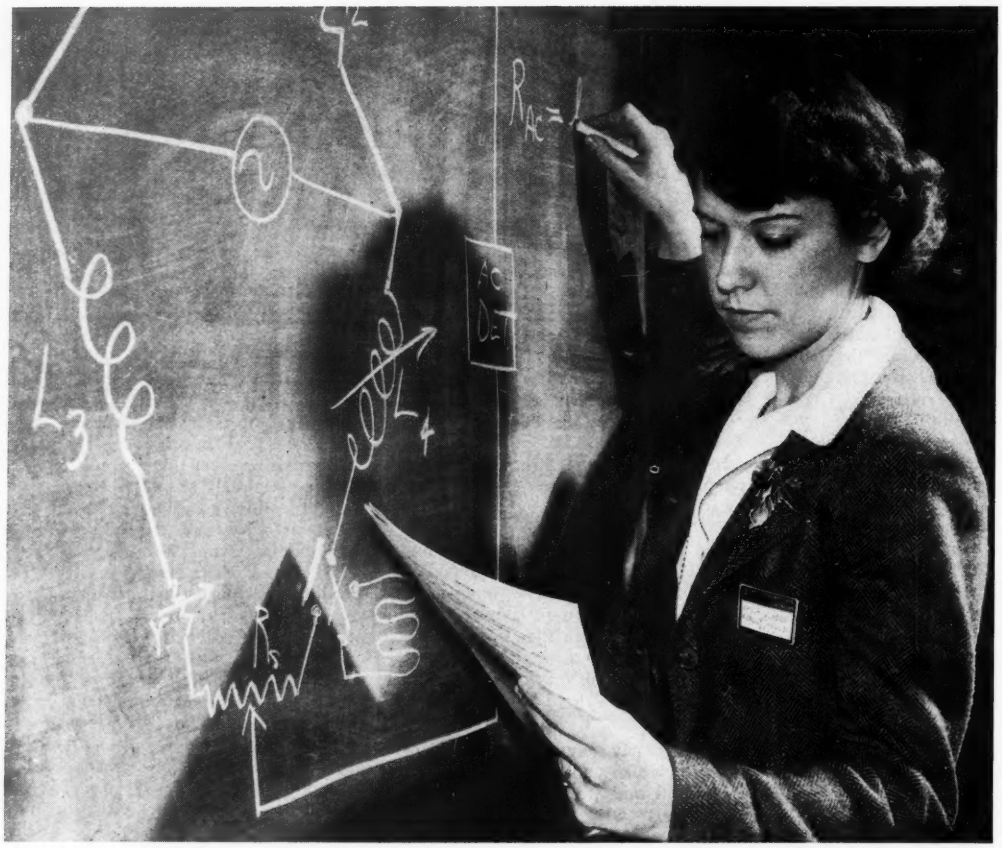
The conclusion seems inescapable that the great reservoir of men, machines and materials which is the basis of the economic and industrial life of our nation is a body whose level changes but gradually from year to year, even under the impact of the greatest war of all time and of the greatest war effort ever made by any nation in history.

Signs are not lacking, however, to indicate that the rate of growth of the industrial war effort is reaching a maximum in some features and has already passed the peak in others.

The satisfactory adequacy of supply of this absolutely essential element in the war effort to date has been the result of wise and careful planning through the years. Many of you will recall the order issued by the War Production Board last August 22nd, stopping construction on 2,200,000 kw. of generating capacity in 85 electric generating plants throughout the country then scheduled for completion in 1943 and 1944 and reducing priority rating on an additional 1,890,000 kw. in 28 government plants. This was done, however, only for the purpose of diverting critical materials to ends felt to be more essential to the prosecution of the war. The Office of War Utilities is watching the situation constantly and with the greatest care. The nation and the industry have been fortunate in having the overall direction of their power affairs in careful and competent hands. The order of August 22, 1942 still left 5,500,000 kw. of new electric generating capacity for completion through 1943 and the early part of 1944.

So far as the electric utility industry is concerned, the inherent stability which enabled it to serve the change from peace to war activity without wide fluctuation will enable it to serve the nation's change back again to the pursuits of peace in a similar fashion. It can be counted upon to contribute its efforts to serve American business and industry in the critical post war period as usefully and effectively as it is serving in the present terrible struggle.

CHARLES W. KELLOGG has been president of the Edison Electric Institute since June 1, 1939. He received his B.S. degree at Massachusetts Institute of Technology in 1902 and his M.S. degree in 1903. After graduation he joined Stone & Webster; his entire business career was connected with that organization. He became manager at Brockton in 1905, later served as manager of properties in the Southwest and Gulf States regions. From 1914 to 1919 he was manager of the Mississippi River Power Co. at Keokuk, Ia. and manager of the Middle West District. He then returned to Boston for work on reports, appraisals and the like. In 1925 he was made president of Engineers Public Service Co., and became chairman of the board in 1934, relinquishing that position to accept his present office. Data presented here are from his paper before the Midwest Power Conference on April 8, 1943.



$R_{ac} = l$

TYPICAL of the role women are playing in the modern world of science and engineering is twenty-four year old Josephine Webb, B.S.E.E., shown above as she presented a paper before the annual technical meeting of the American Institute of Electrical Engineers recently. Despite the fact that she was the lone woman among more than 150 electrical engineers who presented papers at this meeting, she looks quite as "at home" as though she were describing the making of a cake to a domestic science class. Actually, she is discussing the nature of skin effect in bimetallic conductors. Electricity has been Josephine Webb's hobby and business since she became a "ham" radio operator at 13 in Buffalo. She met Herbert J. Webb, her husband to be, when both worked in a radio store there, and married him while they studied electrical engineering at Purdue. At Westinghouse's Pittsburgh laboratories, where she and her husband are both research engineers, Mrs. Webb now works on the development of war-needed electronic power tubes. ¶ Women are found doing important work not only in the laboratories these days but in practically every other phase of engineering and industry. During a recent visit to one of this country's large central stations we found young women in charge of the turbine control boards of the main turbine-generators. They not only took instrument readings but made all the necessary adjustments to keep the generators running. Like Mrs. Webb, they seemed to have no difficulty in fitting themselves properly into the picture. The war is giving women the opportunity of proving to the world that they are just as capable as the men in many fields that, traditionally, have been thought to be the sole domain of the male. More power to them!

WITH THE EDITORS

So You Want to Run a Plant in South America?

AFTER reading about the new plant for the National Cement Co. of Brazil, described in detail in the March, 1943 issue, we hope our readers will not get the idea that all they need do is head for South America waving in one hand a copy of POWER PLANT ENGINEERING and in the other a copy of Electricity, What It Is and How It Acts, to demonstrate to our Latin confreres just how these things ought to be done.

That National Cement power plant is definitely an outstanding job, an indication of the things stirring in South America. If even a small proportion of the industrial expansion plans work out, the continent will be humming like a beehive by 1950.

First of all, look at the industrial and agricultural revolution now being brewed by the U. S. Government in collaboration with South American governments under the aegis of the Co-ordinator of Inter-American Affairs and the Inter-American Development Commission.

◆ The U. S. wants rubber from the Amazon but to get it, food must be grown at the river's mouth, health centers must be set up in the interior, airports must be cleared in the jungles. Because Mexican metals and fibers are needed for war, the U. S. collaborates in rehabilitating Mexico's transport system. The Hemisphere air system is now under Hemisphere, not Axis, control, with many Latin-Americans training as pilots. Chile gets dollars to expand her copper mines. Costa Rica and Panama find a new market for food in the Canal Zone, hence a new type of agriculture. Diversified farming to replace one-crop farming is being fostered in many countries. Scores of new industries are planned for Brazil.

All this will require money—also electric power. But there are technical problems. As shown in the article on the cement plant, a high-pressure, high-temperature, high-economy plant was necessary in this case. There are few of these in South America, hence operators for such plants are scarce. So every detail of operation had to be worked out for simple and automatic operation. Concrete had to replace scarce steel. Parts had to be fabricated for easy assembly in units. Condensing water is hot and full of marine growths. If anything goes wrong, how about spare parts?

When the Latin-American engineer cannot get deliveries of new parts, his equipment is down and usually out, especially during wartime. His North American brother, in overhauling a turbine, finds that he hasn't the proper equipment for removing the shrink ring, so he sends for the manufacturer's service engineer. As an engineer friend points out, the South American power engineer can't do this—he must accept machinery overhauling as part of his routine and under present wartime conditions, with the necessity of making old units last longer, this knack of fixing things is a mighty valuable asset.

After the war, many men will be restless, will have considerable technical training and will want to take up production engineering or power engineering, particularly in foreign countries. There are disadvantages as well as benefits in such foreign assignments and we must be realistic about them.

Engineers going to South America, for example, will be limited to plants operating at around 200 lb. pressure for the most part. Our friend points out that they will miss the excitement and stimulus of new power development. They will need to learn the language and fall into the customs of their newly adopted country. Furthermore, they will be cut adrift from all family ties, personal hobbies and artistic pursuit. Finally, they will need to be much more resourceful and self-sufficient in the matter of maintaining equipment. They can't just pick up the phone and get a box of packing.

Will there be a tremendous market for new and used power equipment in South America after the war? Will Great Britain and the United States continue to dominate the boiler market there? Will Germany lose her previous top position in turbine sales?

The state of development of S. A. countries and the reactions of their peoples are mainly determined by circumstances and environment, as R. P. Crippen points out in his very thorough article in *Electrical Engineering*, Jan., 1943. The middle-class group in Latin America is a much smaller proportionate part of the population than the large middle-class group in the United States. To a great extent, people in Latin America are either rich or poor. There are many excellent schools, but they are not available to as large a percentage of the population as in the United States. In some of the Latin American countries, an appreciable percentage of the population is Indian. There are few good roads, for automobiles are expensive and a much lower percentage of people can afford them.

◆ Until a great pool of middle-class purchasing power—the backbone of any industrial economy—is built up, there will be a lot of wishful thinking about South America.

Spanish is spoken generally throughout all Central and South America except in Brazil where Portugese is used. Very few people realize, however, that half the population of South America speak Portugese and not Spanish. This question of language is far more important than most people think, for even an awkward and halting attempt by an American to speak the language of a country, especially a Latin country, is accepted as a gesture of courtesy and good intentions.

Brazil, the largest country in South America, with approximately half of both population and area, is very rich in natural resources. It is slightly larger than continental United States and has slightly less than one-third the population. It had a total installed generating capacity in 1940 of 1,186,892 kw. and an annual production of approximately 3,000,000,000 kw-hr.

Average kilowatt-hour sales to residential customers in 1939 ranged from 236 kw-hr. per yr. in Argentina, 295 in Brazil up to as high as 433 for Venezuela and 489 for Chile and 516 for Guatemala. In general these averages are low compared with the figure of 1000 kw-hr. being approached as the average for the United States as a whole.

In most Latin-American countries, the supply of servants is adequate and cheap, but they often lack even rudimentary education and are not readily adaptable to new methods of doing things. Electrical appliances, therefore, often deteriorate rapidly or are actually destroyed by incompetent handling.

In the last 10 or 15 yr. there has, of course, been a steady and substantial growth in commercial and small industrial loads and this may be due to a steadily increasing tendency toward local manufacture of many small articles. Argentina and Brazil offer more facilities for the manufacture of electrical equipment and materials than any of the other countries, but for a long time to come many of the large or special articles or those of which not many are needed will continue to be purchased from the United States or Europe. There will not be enough demand for large articles requiring highly specialized manufacturing equipment to allow equipment to be obtained and an organization set up locally to make them economically.

◆ There is little present need, says Mr. Crippen, for inexperienced technical graduates of United States citizenship in these countries. Legal restrictions in the form of labor laws or requirements for engineering licenses practically prohibit engineers of United States citizenship from being employed in engineering work in several countries, unless they were already working in the countries when the laws were passed. The countries having such laws usually have universities with good engineering courses, therefore good technically trained men are available from those schools. Occasionally there is need for an engineer with specialized training to do some particular type of work. There is little occasion to employ inexperienced engineers of United States citizenship in electric utility work in Latin-America, even in those countries where entry is less difficult.

It seems evident that after the war, the relations of the United States with its neighbors to the South are going to be closer than ever before. The Brazilians at least have discovered that we are not the Yankee imperialists that everybody has painted us and that has made considerable difference in their attitude toward us. They have great influence in South America. The mutual solution of present problems will lead to increased mutual respect and understanding.

Those are some of the problems to be solved. Since they are based on power development, we think they constitute a challenge to engineers, who are the great problem solvers.

NEW DIESEL GENERATING U

This is an account of the installation of a new 3000 hp. Diesel-Electric generating unit in the municipal plant of the Hudson, Massachusetts, Light and Power Department. As described in this article, the installation of a new unit is no easy matter these days. Even after it had been proved to the satisfaction of the WPB that this new unit was vitally needed, a great deal of time and effort was expended in getting the engine installed. Hudson, Massachusetts, for many years has operated the largest Diesel plant in New England, but with a growing load due to war industries, a new unit became a necessity

THE INSTALLATION of a new generating unit in a plant these days is not the comparatively simple matter it was a few years ago. Then, one simply sent out bids for a new engine or turbine and after having placed the order and received the unit, installed it. Today, it is quite a different matter. First, you must prove to the WPB that you vitally need the new unit and then, if WPB says yes, you still have to try and get the engine.

Thomas A. Walsh, Manager of the Light and Power Department of the Town of Hudson, Massachusetts, can testify to the difficulties involved in the installation of a new unit because he accomplished this all but impossible task last year.

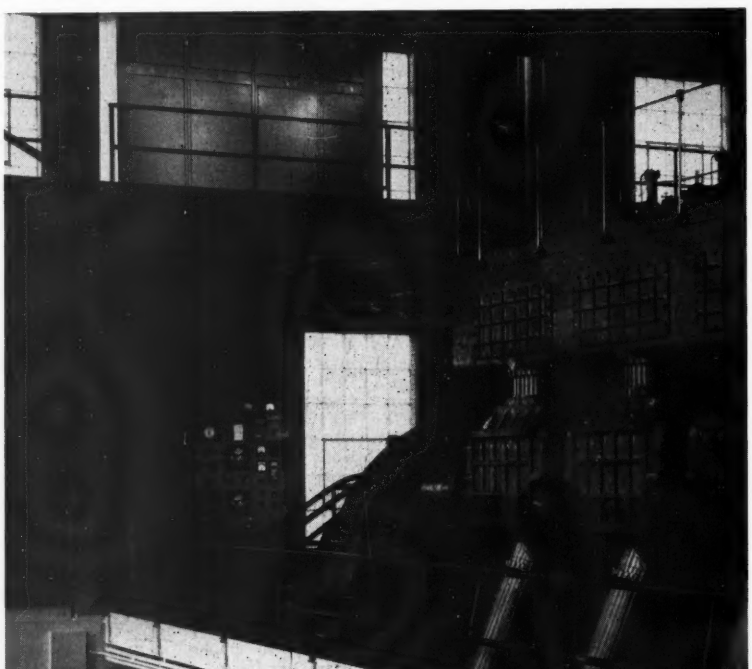


Fig. 1. This view shows a corner of the new unit and the generator control panel. The generator control panel is shown immediately back of the generator. The switchboard cubicles are shown on the gallery above

Hudson has for many years operated the largest Diesel-Electric generating plant in New England, indeed it is said to be one of the largest Diesel plants east of the Mississippi River. Until the present new unit was installed during the latter part of last year the plant had a total installed generating capacity of 3500 kw. divided among five units varying in size from 560 to 1000 kw.

The plant has grown steadily. As shown by the graph, Fig. 3, the peak load increased constantly during the eleven year period between 1930 and 1941 with only two exceptions, in 1932 and 1937, when slight reductions in peak load were recorded. The average growth for the period has been in the neighborhood of 300 kw. annually. This growth in peak load was, of course, the growth under normal conditions.

During the first five months of 1941, however, the increases in peak load were considerably higher than normal, indeed, during the first five months of that year the increase was never less than 200 kw. in any single month. In two of those five months the increase over the corresponding months of the year previous was 600 kw. or exactly twice the rate that prevailed in the past ten years.

This rapid increase in load was, of course, the result of war activity. Hudson is a town of approximately 10,000 people but it has a number of important war industries and these, of course, account for the rapid growth in the load in the last two years. In 1940, the annual output of the plant at Hudson was 10,000,000 kw-hr. In 1941

UNIT FOR HUDSON, MASS.

Fig. 2. A general view of the new addition to the building and the new engine. The area in the immediate foreground is provided for a possible future unit

it went to 13,000,000; in 1942 to 15,000,000, and the indications are that for this year the output will go to 18,000,000 kw-hr. It is evident from this high rate of load growth that the generating capacity of the plant would have been severely taxed if provision had not been made to anticipate the load increase by the installation of this new unit. The chart, Fig. 4, for example, shows that for a period of four months during the latter part of 1940 and the beginning of 1941, the actual peak went beyond the point of safety and cut in on the emergency capacity.

In the course of the analysis, studies were made of the possibility of purchasing wholesale power from the local public utility system but these studies showed definitely that under no reasonable combination of circumstances was it possible for the town to buy power under the contract offered at a price anywhere near the 1940 production cost of 7.3 mills. To get the price per kilowatt-hour down to even 1 cent, it would have been necessary to purchase 6,000,000 kw-hr. per year. This, at the time the studies were made, would have entailed shutting down the local plant, thereby increasing the cost per kilowatt-hour of that portion of the current generated at the plant.

As a result of these studies, it was decided, early in 1941, to purchase a new generating unit and the order was placed during the summer of that year. At the same time plans were made to extend the building to accommodate the new unit since there was no further space available in the existing structure.

December 7th of that year, however, brought "Pearl Harbor" and after that many things happened. The installation of the engine was delayed and because of priorities it became difficult to secure building material. An engine was in process of construction but no crankshaft was available. As a

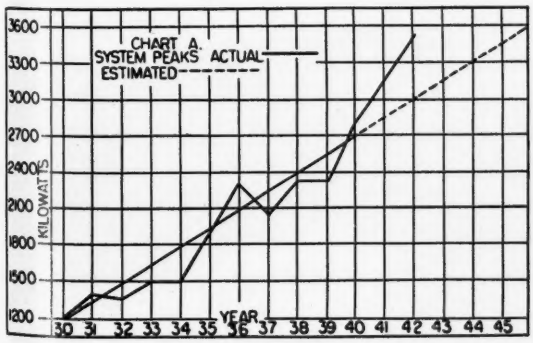


Fig. 3. Chart showing the system peak loads over a period of 12 yr., since 1930

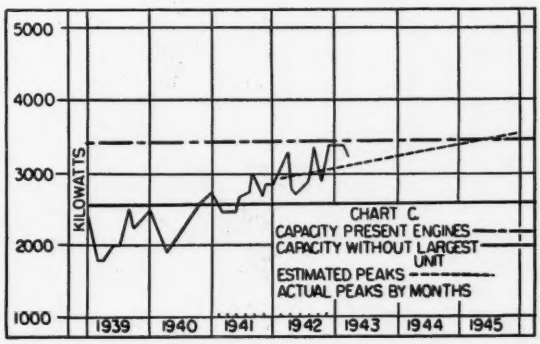


Fig. 4. The expected peaks based on past experience

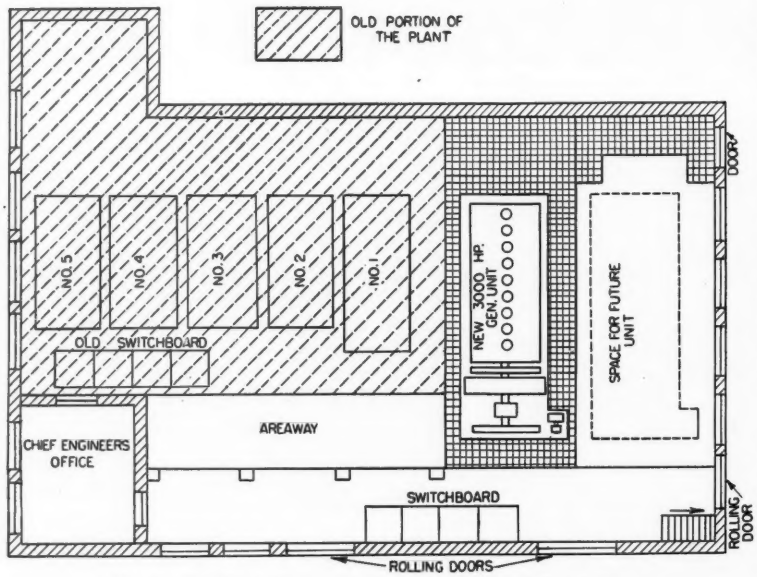


Fig. 5. Simplified diagram showing the layout of the station

consequence, Mr. Walsh made a number of trips to Washington and to Busch-Sulzer in St. Louis in an effort to secure the necessary approval of WPB and to get a crankshaft. After much travel and many conferences an entire new engine which had already been shipped to a midwestern plant was diverted to Hudson. This engine was delivered at Hudson early last fall.

This new unit is a 3000-hp. Busch-Sulzer Diesel engine direct connected to a 2000-kw., 4160-v., Westinghouse Electric and Mfg. Co. alternator. The latter is a 3-phase, 60-cycle unit operating at 240 r.p.m. Excitation is supplied by a 30-kw. 125-v., 240 amp. Westinghouse d.c. generator, V-belt driven from an overhanging pulley on the generator shaft.

As already mentioned, there was no space in the existing building to house the new unit. The existing building was quite old and it had been the intention for a number of years to replace it with a new building. As soon as the engine arrived (early in August) work was started on an addition to the station. Before actual work on the building was started, however, even before the end wall of

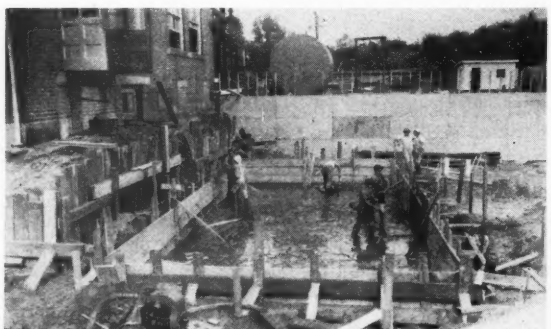


Fig. 6. Excavation for the engine foundation

Fig. 7. The completed foundation

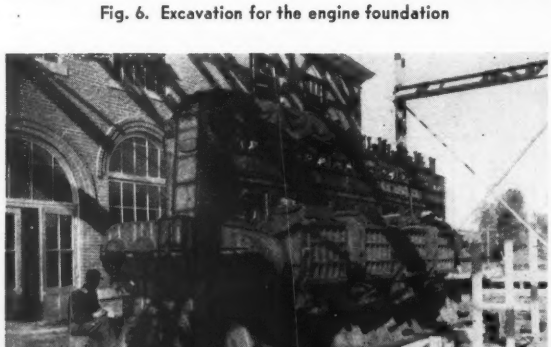


Fig. 8. The new engine on its foundation before the old building was demolished

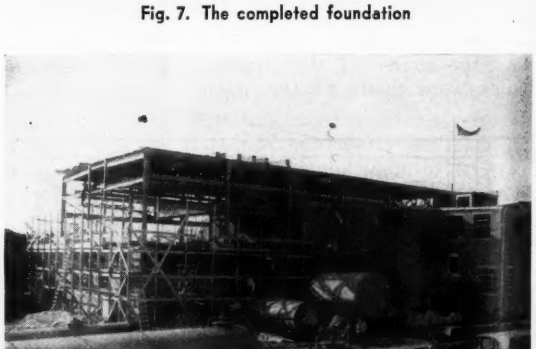


Fig. 9. View showing the construction of the new building around the old building

the old building was demolished, the concrete foundation for the new generating unit was constructed. The steps involved in this work are well shown in the accompanying illustrations. Fig. 6 shows the preliminary excavation for the foundation. As will be noted it is located just outside the building wall. Since the foundation for the new engine extended 2 ft. below the old building walls a plank wall was first erected to prevent the earth underneath the old walls from slipping into the excavation and thus undermining the building wall. At the same time that the foundation for the new engine was laid, the foundation for the extension to the building was also laid. This can be seen in the background in Fig. 6.

The finished foundation is shown in Fig. 7. It is, as will be noted, completely outside of the old building, as a matter of fact, the engine was set on the foundation before the demolition of the old building began. This is shown in Fig. 8.

As soon as the engine was set, the work of taking down the existing building began. The west and south walls together with the roof of the old station were removed opening up the old station to the new. The arrangement of the new part with respect to the old can be seen in the diagram, Fig. 5, which is a simplified plan of the station. In order to provide space for a possible future unit the extension was built large enough to house two engines.

Since the new unit is considerably longer than the old machines, it was necessary to add to the width of the station. For this reason both the west and south walls of the old station were removed and new walls built as shown in Fig. 5. The old roof was demolished and a new roof built over the whole plant. The way in which this was accomplished is shown in Fig. 9. The new steel was set up surrounding the old plant and the new roof laid before the old one was removed.

This work provided virtually a new building. This had been sorely needed from an operating point of view. The old station was quite crowded and the new arrangement provided room for a new metal enclosed generator control panel. This new switchboard is located along the new wall where it gives a much better view of the entire plant than could be had from the old board which was located at one end of the building. The switchgear cubicles are installed on the gallery directly above the generator control panel. As shown on the photograph (Fig. 1) with the exception of the watthour meter, the instruments on this board are temporary. These were picked up here and there and were installed on the panel until the permanent instruments are delivered, probably around June 1st.

The cooling water arrangement for the new engine is shown in Fig. 13. It is a closed system, consisting primarily of a water storage tank, a motor driven centrifugal pump and a heat exchanger for transferring the heat of the water in the closed system to the raw water from the river well. In addition to the jacket water heat exchanger, two other heat exchangers are provided, one, the oil cooler and the other the fuel valve heat exchanger. All of these heat exchangers are Ross exchangers, cooled by water supplied from the river wells by two centrifugal pumps. These are Pennsylvania Pump & Compressor Co. pumps

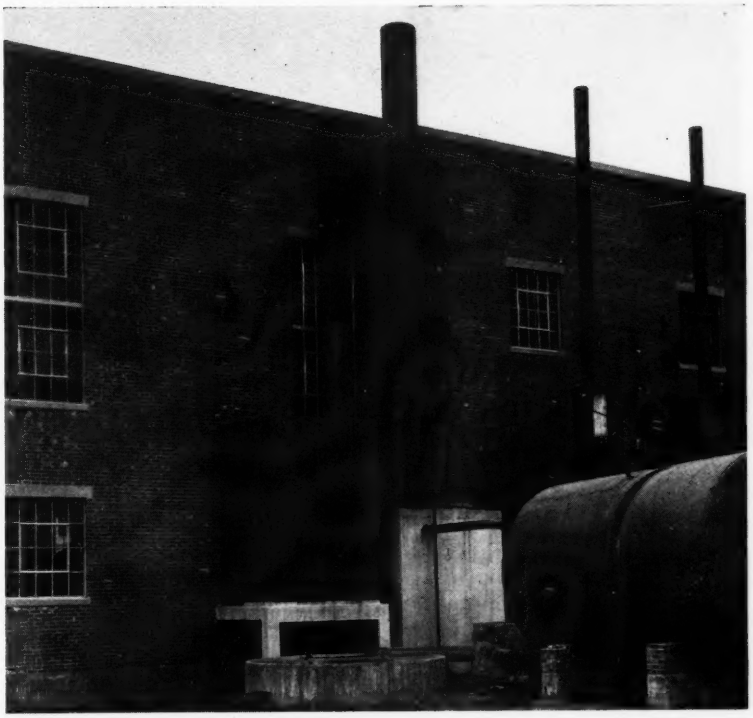


Fig. 10. The exhaust stacks and associated equipment outside the new building

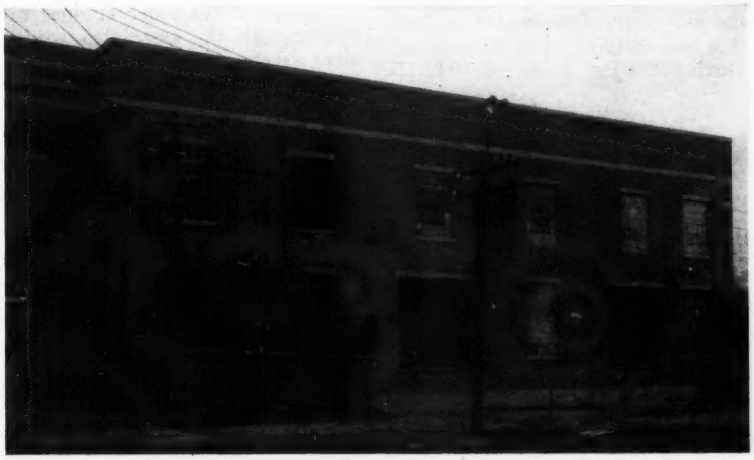


Fig. 11. The transformer bank is protected by a machine gun bullet proof barricade

Fig. 12. Another view of the new engine

rated at 700 g.p.m. and driven at 1750 r.p.m. by 15 hp. Westinghouse motors. Due to copper restrictions, the tubes in the heat exchangers and lubricating oil coolers are steel.

The new Busch-Sulzer Diesel engine is a 9 cylinder unit, the cylinders being 20½ in. in diameter with a 27½-in. stroke. It is equipped with an engine driven blower. It has a normal rating of 3000 hp., equivalent to 2110 kv-a. net. The brake m.e.p. is 60 lb. per sq. in. and the piston speed is 1100 ft. per min. It is served by American traveling screen filters. The inlet and outlet silencers are Burgess units.

This new unit will add greatly to the ability of the station to carry the steadily increasing load and will permit better maintenance of the older engines. They have been run almost continuously during the past year. One engine, in fact, was run 28 days without stopping. During the last 6 mo. of 1942 all five of the engines were run every day except Sundays. Sundays the load generally falls off enough to stop at least one engine and sometimes two. This, necessarily, has confined maintenance to the barest essentials. With the new engine in operation it will be possible to devote more time to the maintenance of the older engines.

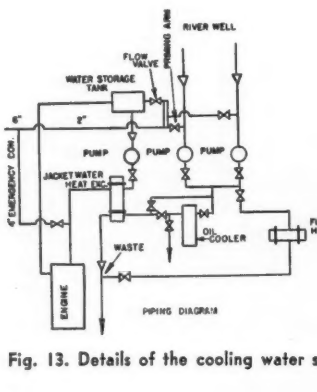


Fig. 13. Details of the cooling water system

The new building itself constitutes a great and much needed improvement. The construction of the building as well as the installation of the new engine was carried out under the supervision of Arthur Nelson, consulting engineer of Boston, Mass., and he has produced an installation of pleasing appearance and of practical utility. The plant is located close to the Assabet River from which the cooling water for the engines is taken.

A list of the older engines together with the associated equipment is shown in the accompanying tabulation.

Electricity is generated and distributed at 2300/4000 v., 3-phase, 60-cycle, all of the system being of overhead construction except in the business district where a "White-Way" system of street lighting is supplied through underground conduits. Electricity for domestic use and commercial lighting is supplied to the customer at 110/220 v., 3-wire, single phase and for power customers at 550/2300 v., 3-wire, 3-phase. The department maintains about 96 miles of lines with nearly 456 miles of wire in place.

Domestic rates for electricity are as follows:

First 20 kw-hr. . . . .5 c. per kw-hr.
Next 80 kw-hr. . . . .3 c. per kw-hr.
Next 100 kw-hr. . . . .2 c. per kw-hr.
Over 200 kw-hr. . . . .1 c. per kw-hr.

This rate applies to residence lighting, cooking, water heating, oil burners and all non-commercial appliances used in a single private dwelling as well as to commercial installations where the total connected load does not exceed 1000 watts. Primary power to commercial customers is sold as low as 0.9 c. per kw-hr.

EXISTING EQUIPMENT IN THE HUDSON PLANT

Two 900 hp. 17 x 24 in., 8-cylinder, air-injection Diesels, direct connected to 615 kw. generators operating at 2300 v., 60 cycle, 3-phase and with a chain driven 13 kw. exciter.

One 675 hp. 17 x 24 in., 6-cylinder, air-injection Diesel, direct connected to a 460 kw. generator and with a chain driven exciter.

One 1200 hp. 20 x 24 in., 6-cylinder mechanical injection Diesel, direct connected to an 835 kw. generator and chain driven 15 kw. exciter.

One Type 8-T-36 Alco-Sulzer two cycle single acting mechanical injection Diesel of 1480 B.H.P. at 277 r.p.m., direct connected to a 1000 kw. generator.

Engine manufacturer: American Locomotive Co.

Generator manufacturer: General Electric Co.

Switchboards and instruments: General Electric Co.

Motor generator exciter: General Electric Co.

Fuel oil: No. 4 Diesel.

Lubricating oil: Texas Co.

Silencers: Maxim.

Exhaust pyrometers: Bristol Co.

Centrifuges: Two, De Laval Separator Co.

Oil transfer pumps: Viking and Perfection.

Emergency air compressor: Worthington 4¾ x 1½ x 5 in. compound direct connected to Novo gasoline engine and 5 hp. Wagner motor.

Traveling crane: New Jersey Foundry Machine Co.—10 ton capacity.

Raw water pumps: Two 6 in. Lawrence Machine & Pump Co.

Jacket water pumps: One Gould, 300 g.p.m. and one Gould, 1000 g.p.m.

Emergency make-up valve: Golden-Anderson.

Street lighting equipment: One 50 kv-a., one 35 kv-a., one 25 kv-a. G. E. Co. constant current air-cooled transformers, 2300 v. primary, 6.6 amps. secondary.

Fuel oil tanks: Two 20,000 gal. capacity, above ground.

Oil reclaimer: One Youngstown-Miller Co.

Lube oil tank: 1—10,000 gal. above ground.

New Western Hydroelectric Plant

This is a description of one of the large new hydroelectric generating stations which has recently been completed and placed in operation by the U. S. government. Because of censorship restrictions the name of the plant nor its location cannot be disclosed but otherwise this is a complete description of the plant. The plant contains four 30,000 kv-a. generating units, three of which are now in commercial operation and the fourth, now being installed, should be ready to go into operation in June of this year

By L. N. McClellan

Chief Electrical Engineer, U. S. Bureau of Reclamation

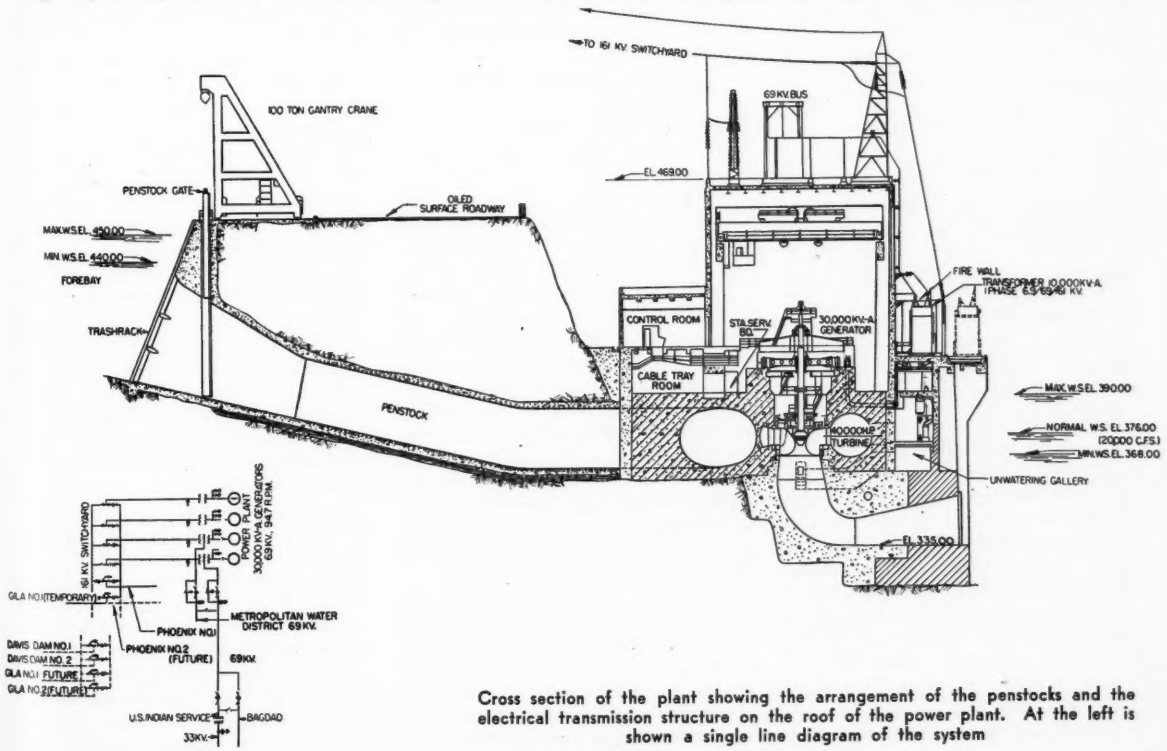
ANOTHER LARGE hydroelectric plant recently was added to the group of power plants built and operated by the U. S. Bureau of Reclamation. This new power plant is located on a western river at a dam built a few years ago for the purpose of diverting and desilting water for a large aqueduct serving a number of municipalities in the Southwest. The dam also provides flood control and creates a head of 80 feet for power purposes.

The power plant contains four generating units of 30,000 kv-a. capacity each, three of which are now in commercial operation and the fourth is being installed and will be ready for operation in June of this year.

An excavated forebay connects the lake above the dam with the penstocks. The entrance to the forebay is protected by a trashrack structure with a bridge on which a crawler type crane can be used to remove trash from the trashracks. Each penstock is provided with a fixed-wheel type of shut-off gate 22 feet in width and 35 feet in height operated by a motor-driven gantry crane. The gates may be held in the raised or open position by mechanical latches. The penstocks are 22 feet in diameter and vary in length from 126 to 285 feet. The penstock tunnels were excavated to a minimum diameter of 27 feet and the space between the steel penstocks and the rock was filled with concrete and then grouted under low pressure. The steel penstocks are of welded construction and were fabricated at the site. The steel plates vary in thickness from $\frac{5}{8}$ to $\frac{5}{16}$ of an inch and stiffener rings made of 1 by 8-inch bars spaced 2 feet, 6 inches are welded to the outside of the penstocks.

Turbines

The turbines are of the vertical-shaft, reaction type with plate-steel casings and are rated at 70,000 hp. at a head of 77 feet. The turbine runners are single-piece steel castings. At full load and rated head each turbine will utilize about 5,000 cubic-feet of water per second. The turbine guide bearings are of the oil-lubricated babbitt-lined type. Each turbine is provided with two motor-driven oil pumps for forcing lubricating oil through the guide bearing. One of the oil pumps is driven by ar alternating-current motor and it is the normal supply; the second oil pump is driven by a direct-current motor operated from the station storage battery, is a stand-by for the first, and is arranged to start



Cross section of the plant showing the arrangement of the penstocks and the electrical transmission structure on the roof of the power plant. At the left is shown a single line diagram of the system

automatically upon low-oil pressure. The servo motors which operate the turbine wicket gates operate with oil under a pressure of 250 to 300 pounds per square inch and they are designed to make a complete opening or closing stroke in five seconds. Special means is incorporated in the servo motors for retarding the rate of closure of the turbine wicket gates as they near the closed position to prevent excessive pressure rise in the penstocks.

Governors

The governors are of the actuator type with the speed-responsive element driven by an electric motor which receives its power supply from a small permanent magnet alternating-current generator which is direct connected to the shaft of the main generator. This type of governor drive has been adopted as standard by the Bureau and has proved quite satisfactory. Each governor is provided with duplicate oil pumps, one of which is a stand-by for the other, and both are arranged to start and stop automatically.

Generators

The generators are of the totally enclosed water-cooled type and are rated at 30,000 kv-a., at unity power factor. They operate at 6,900 v. and 94.7 r.p.m. Each generator has a main and pilot exciter, both of which are direct connected to the upper end of the main generator shaft. The rotating parts of the generator and turbine are carried by a thrust bearing of the Kingsbury type located above the rotor. Each generator has two guide bearings, one above and the other below the rotor. The flywheel effect of the generator rotor is 50,000,000 lb. at 1-ft. radius. Air-operated brakes capable of stopping the rotor from half-speed in 7½ minutes are provided and the brakes may be used as hydraulic jacks to lift the rotor off the thrust bearing. The excitation system has a speed of response of .5 and operates at 250 v.

Transformers

Parker Power Plant incorporates the unit system with a bank of transformers for each generator. The transformers are of the single-phase water-cooled, inert gas type rated 10,000 kv-a., 6,800-161,000 v.

Each bank of transformers is connected to the 161-kv. switching station by a short overhead circuit and a 161-kv. oil circuit breaker. The switching station has a main and auxiliary bus. Each outgoing 161-kv. transmission line has two oil circuit breakers, one on each bus. The 161-kv. oil circuit breakers have an opening time of five cycles. There are two 161-kv. transmission lines, leaving the switching station, one of which extends to a terminal substation near Phoenix, Arizona, and the other connects with two substations, one near Yuma, Arizona, and another in Imperial Valley. A 115-kv. transmission line extends from the Phoenix substation to Coolidge and Tucson, Arizona. A 69-kv. transmission line connects with the power system of the Metropolitan Water District through which an interconnection is made with the Boulder Power Plant. Another 69-kv. transmission line extends from the power plant to a copper mine and a 33-kv. line supplies power to the Colorado Indian Reservation and a War Relocation Center.

The power plant was designed under the author's direction and under the general direction of Mr. J. L. Savage, Chief Designing Engineer. The engineering and construction work of the Bureau is under the general direction of Mr. S. O. Harper, Chief Engineer, Bureau of Reclamation, with headquarters at Denver, Colorado, and all activities of the Bureau are under the general charge of Mr. John C. Page, Commissioner of Reclamation, Washington, D. C.

CHEMICAL CLEANING of Steam Boilers

By FRED D. MOSHER

ESSENTIALLY, chemical cleaning involves the use of scale-dissolving acids to which have been added inhibitors to prevent metal attack by the acids. The acids most commonly used are sulfuric and hydrochloric; the selection of the acid depending on the nature of the deposit to be removed. The solids generally deposited in steam equipment by feedwater are:

(a) The various silica compounds
(b) Calcium and magnesium salts, carbonates and phosphates
(c) The oxides of iron

These compounds are readily removed by the two acids mentioned, with the exception of the silicates which are not all soluble in these acids. When silicates are present, however, they are quite commonly present with other compounds which upon dissolving render the silicates easily removable by the scrubbing action of the circulation. When the cleaning acids react with the boiler water impurities, typical reactions for hydrochloric acid are:

$$CaCO_3 + 2HCl = CaCl_2 + H_2O + CO_2$$
$$FeO + 2HCl = FeCl_2 + H_2O$$

Since the acids will attack the metal of the vessel being cleaned, inhibitors are used to retard this attack.

It is important in chemical cleaning to use the acid which will best remove the scale present, and where samples of the deposits are obtainable it is advisable that it be tested with acids to determine the cleaner that should be used. The inhibitor must also suit the acid, and in connection with this the various chemical manufacturers have made extensive tests, and those unfamiliar with chemical cleaning should seek their advice or consult competent chemists on the materials and procedure to be used. The art of chemical cleaning has advanced rapidly, and it would not be correct to say that there is any single best procedure and material. The following acids and chemical cleaning compounds have been used for boiler cleaning: hydrochloric acid, sulphuric acid, commercial inhibited acid compounds, ammoniacal ammonium citrate, and sodium hydrate. Materials which have been used as inhibitors are: glue, starch, barium salts, formaldehyde, commercial inhibitors, and organic compounds. The effectiveness of most inhibitors is greatly reduced by temperature so that during cleaning it is advisable to keep the circulating solution below 150 deg. F.

The first step in preparing a boiler or other vessel for acid cleaning is to isolate it from the other apparatus by blanking lines or otherwise closing connections. All non-ferrous parts must be removed to prevent attack by the acid solution; valves used for the

cleaning process should be of steel construction. Gas vents should be provided at high points or pockets in the apparatus where gas might accumulate; when gas pockets form, the inhibitor is not carried with the gas and danger of corroding the metal is prevented by venting the gas to atmosphere. The apparatus must be kept completely filled with the acid solution during the cleaning period, and this is checked frequently by opening the vents.

Typical Set-up

The following is a set-up for a typical chemical cleaning:

1. A tank or steel barrel of 50 gal. capacity, open at one end. A line, about 1½ in. in diameter, should be connected to the highest point of the apparatus and discharge to the open tank. This is the return line, and a sewer drain line should be connected to it between the apparatus and the tank. An open ended steam line should discharge to the tank, and a cold water supply, either hose or pipe, should be available for filling the tank.

2. A 20 g.p.m. pump operating at 100 lb. head is connected through a 2 or 2½-in. line to the bottom of the tank for suction. The discharge of the pump is connected by a 2-in. line to the lowest point of the vessel to be cleaned, such as a bottom blowoff or bottom drain.

On starting up, the amount of water necessary to fill the apparatus should be known or determined, and the pump should be operated to pump clean water until the return line from the apparatus starts discharging; beyond this it is only necessary to keep sufficient level in the tank to submerge the steam line and to maintain the pump suction. Heat is added to the water in the tank until the maximum of 150 deg. F. is maintained at the discharge from the apparatus being cleaned. At this point the inhibited acid is added; should the tank level become higher from the condensed steam it should be reduced to the required minimum.

Assuming that hydrochloric acid is being used, and it is in the uninhibited state, the acid ought to be 18 to 20 deg. Baumé and of sufficient amount to make a solution of one of acid to five of water for cleaning. The selected inhibitor can be mixed with the acid by drawing from each container 1 or 2 gal. of acid and dissolving the required amount of the inhibitor; the mixture of acid and inhibitor may then be returned to the acid or added to the tank when the total acid is added.

With the circulating water at the desired temperature the acid is added in a steady stream, or as continuous as is practicable, and while the acid is being poured into the tank the heat supply must be shut off. The pump is kept in operation during the addition of the acid.

Cleaning Procedure

Following is the cleaning procedure:

1. With all the inhibited acid added to the circulating system, resume heating to maintain the required temperature. Make frequent checks at the return line for acid, using litmus paper or acid indicator. When acid shows at the return line, check the time and circulate for ½ hr.

2. At the end of the ½ hr. period turn the cold water supply to the tank and open the return line to the drain or sewer. This is the washing period and circulation is continued until all acid has been washed out. During acid circulation the vents should be frequently opened for gas release. Heat is continued during the washing period.

3. When the washing returns run clear, a simple test with soda ash is made with a small amount of the returns; on adding a pinch of soda ash to a sample of the returns, the sample will turn a greenish blue if dissolved iron oxide is present. The change in color indicates that hydroxides of iron are being formed, and the solution should not be fully neutralized during this period since deposits of a sticky nature may be formed. When the greenish color no longer shows when a test is made, the circulating solution may be turned back to the tank and made alkaline with the necessary soda ash. Recirculation is continued for 15 min. and the alkaline solution is dumped to the sewer. Clean water is then run through the unit for 10 min. and at the end of this period the apparatus may be made ready for service.

The following is an example of how a high-pressure boiler was chemically cleaned recently. The boiler is operated at 2000 psi. pressure and delivers 50,000 lb. steam per hr. Safety valves were removed and the nozzles blanked. The steam outlet was blanked and a vent was provided at the top of the steam drum; the interior parts of the feedwater check were removed and the chemical line was connected to the feed line between the check and the boiler.

Cleaning materials used were two carboys of hydrochloric acid to which had been added 3 lb. of standard inhibitor. The water was heated to 138 deg. F. before the inhibited acid was added. While the inhibited acid was being added to the cleaning tank the pump was kept running. About 5 min. were taken to add the chemicals, and the heat was shut off the tank during this period. When the acid started coming back from the boiler, as checked with litmus paper, the time was checked.

Circulation was continued for 35 min. and then the chemical solution was turned into the sewer; the fresh water line was opened to the tank and the heat to the tank was increased. The clean, heated water was pumped through the unit for 32 min. at which time the sewer drain showed clean returns. A check with soda ash showed that no precipitate was formed in a sample of the water. At this point the circulating water was turned back to the tank to be re-circulated, and about 15 lb. of soda ash was mixed with the water in the tank; the alkaline water was then circulated for 40 min. and then dumped to the sewer with clean water being added to the tank for flushing. At the end of 10 min. the circulating was stopped and the boiler was made ready for service.

The chemical cleaning method outlined has been successful in numerous cases where other means of removing deposits were found to be impracticable. There are variations of the method such as using uninhibited acid in greater concentration, and methods of "boiling out" without re-circulation; much more acid is used in this method. Those using this method of cleaning, however, should have the advice of a competent chemist who fully understands the general procedure of cleaning with chemicals. Like everything else practice will tend to introduce simplifying features for the set-up, and many short-cuts and refinements will be developed. This method of cleaning is worth the study of power plant engineers who are seeking ways of reducing cleaning costs, and means of taking the drudgery out of equipment cleaning.

Interrupting Capacity — What It

By WAYMAN A. HOLLAND

Switchgear Division, General Electric Company

IN ANY ELECTRIC CIRCUIT there is always the liability of a fault and to relieve apparatus and cables from the damaging effects of continued short circuit current it is necessary to employ some form of protective interrupting device.

In addition to the necessity for this interrupting device it is advisable to have also, at all times, a means for convenient, quick, and easy opening and closing of the circuit under normal operating conditions.

In some cases, particularly in low-voltage, low-capacity circuits, these two needs are filled by a knife switch with fuses, the fuses supplying the protection, and the switch the control. In important modern circuits, and particularly those of heavy duty, the best practice employs a circuit breaker for the combined duty of protection and switching. Aside from the relative quality of short circuit protection provided by a circuit breaker versus a fused knife switch, the breaker, in this double duty of protection and switching, has the advantage of safety and interrupting ability in that its interrupting element is always effective, whether the breaker is opened manually or automatically on overcurrent. In the case of the fused switch the interrupting element (the fuse) is not effective when the circuit is opened manually by pulling the switch, and the switch has only limited interrupting capacity.

Interrupting Capacity

It is obvious that the protective devices must have adequate current-carrying capacity and proper voltage rating, but these are not the only requirements—the devices must have also ample *interrupting capacity*. This means that the device must be able to clear safely the maximum short circuit current it is possible for the system to produce in the particular circuit. The device must also be able to withstand without injury the high momentary currents liable to exist before interruption.

Short Circuit Current

The normal load current of a circuit is no definite indication of the magnitude of the short circuit current that may occur, or of the required interrupting capacity of the protective device. Nor can generalizations be made regarding this magnitude, or "rule-of-thumb" methods set down. The value of fault currents in any electric circuit, at a given voltage, depends upon the impedance (the resistance and the reactance) of the circuit, and the possible magnitude of the short circuit is equal to the quotient of the voltage divided by the impedance. The voltage is always known and the problem is to know the correct value of impedance to use.

Calculations

The exact computation of the maximum possible short circuit current in a given circuit is a very complicated matter, involving intricate mathematical analyses and complete system layout studies. Fortunately, there is a relatively simple way of arriving at approximate values that are close enough to actual values for all practical purposes.

This method involves simply the calculation of the maximum symmetrical short circuit current which is then multiplied by established factors to obtain the total short circuit current to be interrupted and the momentary current which the devices must withstand.

It is common practice in connection with alternating current machines and transformers to express resistance, reactance, and impedance in per cent, as for example, 15 per cent reactance. This means that the reactance is such that with normal current the voltage-drop due to the reactance is equal to 15 per cent of the normal voltage of the circuit. The higher the per cent reactance, the lower is the short circuit current. In the calculations this percentage value is frequently expressed as a decimal, the 15 per cent becoming 0.15 and then known as the per unit (p.u.) value. The p.u. value is becoming more and more commonly used.

In alternating current generators, rotating machines, and transformers the resistance as compared to the reactance is usually negligible and, consequently, the reactance and the impedance are considered to be the same. It is, accordingly, common simply to refer to the reactance rather than to the impedance. Thus, one will find in rotating apparatus ratings

The relation between the normal current carrying capacity of a switch or circuit breaker as compared to its interrupting capacity is not always understood by the operator of electrical equipment. As pointed out by Mr. Holland in this article, a circuit breaker or fuse must be designed not only to carry the normal current on the circuit and to interrupt this current but it must be able to clear the maximum short circuit current that the system is capable of producing. Before a circuit breaker or fuse is installed, it is necessary therefore to determine quite accurately what this short circuit current is likely to be. The exact computation of the maximum short circuit current is a rather complicated matter but as shown in this article there are simple ways of arriving at approximate values that are close enough to the actual values for all practical purposes. These methods are described by the author and actual examples are given to show exactly how they are applied to actual problems. In case one might be inclined to underestimate the importance of properly analyzing this aspect of electrical systems we urge them to read what Mr. Holland has to say about the practical considerations of the subject. The mere fact that the devices installed on a particular system have never failed is no proof that they will not fail under severe short circuit currents. It is better to calculate what the magnitude of these currents are likely to be than to find out, through bitter experience, that they are greater than the equipment can safely interrupt. The calculations are comparatively simple.

Means and How It Is Calculated

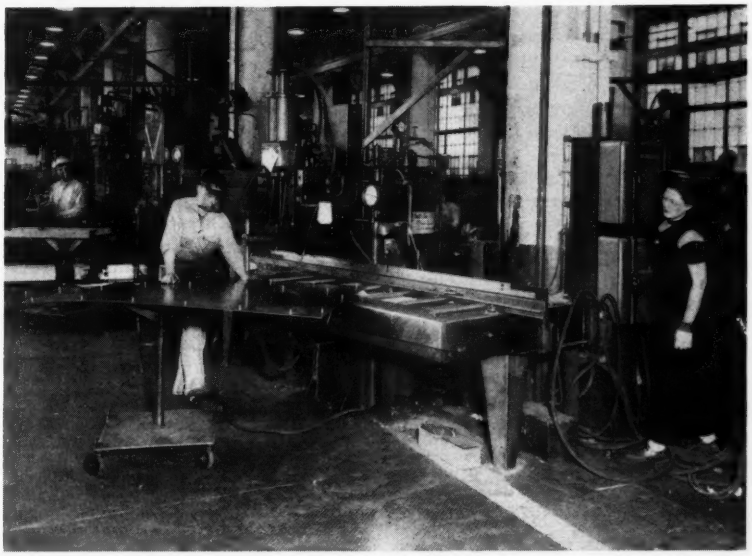


Fig. 1. In this welding shop the air circuit breakers at the right provide easy and convenient switching to keep the power on and give full assurance of adequate protection against short circuit

and data frequent reference to reactance, including "subtransient reactance," "transient reactance," etc., with never any reference to impedance.

The reactance given (in percentage or per unit) for any piece of apparatus is based on the normal kv-a. of that particular piece of apparatus.

For short circuit current calculations, it is necessary to add the reactances of the various parts of the system (generators, transformers, etc.) up to the point of the fault. Per unit values must all be converted to the same kv-a. base. This base may be any convenient figure, but it is usual to use the kv-a. of one of the machines or the total kv-a. of that part of the system under consideration.

To convert the p.u. value of one "Apparatus Unit" (generator, transformer, etc.) to the p.u. value at the chosen base, multiply it by the ratio

$$\frac{\text{Chosen Kv-a. Base}}{\text{Kv-a. of "Apparatus Unit"}}$$

The value of any reactance (as well as resistance or impedance) given in ohms is changed to p.u. terms by the following formula:

$$\text{p.u. at chosen kv-a.} = \frac{\text{chosen kv-a.} \times \text{ohms} \times 1000}{\text{volts}^2}$$

For calculating the short circuit current for interrupting device application near generators, the generator *subtransient reactance* is used (subtransient reactance is that initially low reactance of the machines immediately following the fault and lasting through only the first few cycles of the fault current). On feeders, for short circuits at a point just off the buses, the total short circuit current will be the sum of the currents contributed by each generator, equal to its normal current divided by its subtransient p.u. reactance (See Case a, Fig. 2). For more remote points, however, it is necessary to include the reactance of intervening connections or apparatus. This involves the finding of the equivalent p.u. reactance of all the generators combined. This is done by reducing the subtransient reactances of each of the several generators to the p.u. value at the chosen kv-a. base and then computing the value of the reciprocal of the sum of the reciprocals of these individual p.u. values. To the value of this equivalent p.u. subtransient reactance of all the generators there must be added the several p.u. reactances of the elements of the circuit in series (all after conversion to the common kv-a. base) to get the total reactance. The "symmetrical short circuit current" previously referred to is then calculated by dividing the normal current (of the base kv-a.) by this total p.u. reactance (See Case b, Fig. 2).

Short circuit currents, however, are not ordinarily symmetrical. At the inception of the short circuit there is usually superimposed an offset component, called the direct current component, which decays quite rapidly. This d-c. component plus the symmetrical component makes up the total short circuit current of only a few cycles duration at the initial value.

For making short circuit current calculations, the subtransient reactance values of generators are readily obtained from the manufacturers, or if approximate values are desired for tentative consideration, Table I can be consulted for typical values. Approximate values of transformer reactance are given in Table II.

The reactance of conductors, wires, and cables, can be determined from published data.

In most installations there are motors running and when short circuits occur these exert a regenerating effect, becoming generators for the time being, and adding their contributions to the short circuit current from the usual generating sources (See Case c, Fig. 2). The values of the motor reactances are obtainable from the manufacturers but for the tentative data typical values of these are also given in Table I.

One is now ready to go into the matter of determining the short circuit current interrupting capacity a properly selected and applied device must have.

Fuses

Early in this article mention was made of the use of fuses for the protection of low-voltage circuits, with knife switches for the control of opening and closing needs. The operation of any fuse (both high and low voltage) under short circuit current conditions is so fast that it clears during the subtransient conditions and before the d-c. component has time to die out, so its capacity must be based on the total current including the transient offset. In the general case this is 1.6 times

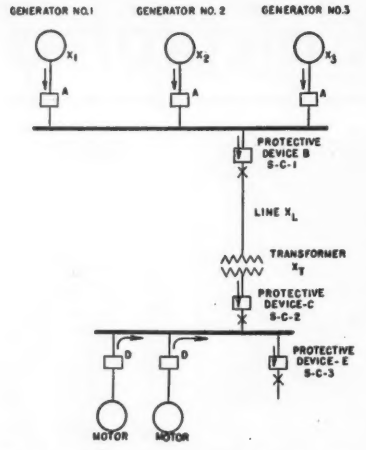


Fig. 2. Diagram illustrating the required interrupting capacities of protective devices located at various points in an electric system (arrows indicate flow of short circuit current):

(a) Short circuit at S-C-1. Protective device B required to interrupt current equal to the sum of the short circuit currents of each generator

(b) Short circuit at S-C-2. Here the protective device C is required to interrupt short circuit current calculated by reducing the generator reactances to one equivalent value and adding the line and the transformer reactances. Assume that the reactances given for each element are the p.u. values reduced to the chosen base kva, then the total reactance to the point of the short circuit is equal to

$$\frac{1}{(1 \div X_1)+(1 \div X_2)+(1 \div X_3)} + X_L + X_t$$

(c) Short circuit at S-C-3. Protective device E required to interrupt current same as that of C plus the short circuit contributions of the motors

the symmetrical short-circuit current, but for fuses rated 15,000 v. and below, not applied directly to a generator bus of high capacity, the resistance introduced by lines and intervening apparatus is usually so great that the total current will not exceed 1.2 times the calculated symmetrical short circuit current. Applications on this basis are considered safe. The contributions from motors must be added to the current from the power source.

Air Circuit Breakers

Also, early in this article, mention was made of circuit breakers for the combined function of control and protection. Air circuit breakers, like fuses, also operate very quickly under short circuit conditions and they tend to interrupt during the period of the d-c. component. The ratings of air circuit breakers are based on the average total current in the three phases of a 3-phase circuit, and this results in a multiplying factor of 1.25, so that the interrupting capacity of an air circuit breaker must be 1.25 times the symmetrical short circuit current. The contributions from motors must be added. The momentary current is figured as 1.25 times the symmetrical current so that the momentary current rating required for low-voltage air circuit breakers is the same as their interrupting rating.

Power Circuit Breakers

Power circuit breakers, applied on a-c. circuits over 750 v., are not so rapid in their operation, and their required interrupting capacity is based upon the various speeds of interruption of the different types as in the table below.

	Multiplying Factor
8 cycles.....	1.0
5 cycles.....	1.1
3 cycles.....	1.2
2 cycles.....	1.3

The symmetrical short circuit current must be multiplied by the factor given to find the required interrupting capacity.

In addition to the interrupting rating, these breakers must be able to withstand the initial inrush current, and therefore for general cases they must have a momentary current capacity equal to 1.6 times the symmetrical current. At 5000 v. and below, unless the short circuit is fed predominantly by directly connected synchronous machines or through current limiting reactors only, this multiplying factor, as stated previously, may be 1.4.

It is considered that the regenerative short circuit current contributions of induction motors will have died out by the time an 8-cycle power circuit breaker operates, and consequently for their interrupting capacity these con-

TABLE I

Approximate Reactance Values of A. C. Generators and Motors Three Phase, 60 Cycle*, 2300 Volts and Above

Apparatus	Subtransient Reactance Per Cent** Range	Mean†	Transient Reactance Per Cent** Range	Mean†
Turbo-generators				
1800 r.p.m.	10–17	13	Not used in normal short-circuit calculations.	
3600 r.p.m.	7–13	10		
Salient-pole Generators (With Amortisseurs)				
Waterwheel-driven	20–35	25		
Engine-driven	15–30	20		
Condensers				
Air-cooled	18–30	25		
Hydrogen-cooled	21–35	30		
Synchronous Converters	15–35	20	20–50	25
Synchronous Motors				
720 r.p.m. and above	10–20	17	15–35	25
600 r.p.m. and below	20–35	30	20–50	40
Induction Motors	15–25	25	.....	..

*In general: the reactances of 25-cycle machines will be very approximately 80 to 90 per cent of average 60-cycle machines. There is little difference between 50- and 60-cycle machines.

**Per cent based on machine kv-a. rating.

†For close calculations specific data for the particular apparatus should be obtained. As is indicated under "range," actual reactance values vary considerably from mean.

TABLE II

Approximate reactance values of distribution and power transformers 60 Cycle*

High-Voltage Rating KV.	K-va. Rating	Approximate Reactance—Per Cent**
DISTRIBUTION TRANSFORMERS—1-PHASE†		
2.4 to 4.8	100 or less	1.7 to 3.4
	150 to 500	3.3 to 4.4
6.9 to 13.8	100 or less	1.7 to 4.8
	150 to 500	4.0 to 4.9
22 to 33	500 or less	4.1 to 5.5
44 to 66	500 or less	5.5 to 7.5
POWER TRANSFORMERS—1-PHASE OR 3-PHASE		
2.2/3.8Y to 15	Above 500 k-va.	4.5 to 7
Above 15 to 25		5.5 to 8
Above 25 to 37		6.0 to 8
Above 37 to 50		6.5 to 9
Above 50 to 73		7 to 10
Above 73 to 92		7.5 to 10.5
Above 92 to 115		8 to 12
Above 115 to 138		8.5 to 13
Above 138 to 161		9 to 14
Above 161 to 196		10 to 15
Above 196 to 230		11 to 16

*For 25-cycle transformers reactances are approximately as follows:
Distribution Transformers—80 per cent of 60-cycle reactance.
Power Transformers—Approximately the same as the minimum value given for 60-cycle.

**Per cent based on Kv-a. rating.

†For 3-phase transformer use reactance of 1-phase transformer of one-third the rating of the 3-phase transformer.

tributions are neglected. They must be considered, however, for the momentary current capacities. This consideration sometimes makes it necessary to select a larger capacity breaker than merely the interrupting needs require. This is particularly true in cases of large motors directly connected to the bus. In the case of synchronous motors, the contribution for momentary rating requirements of power circuit breakers is based on the subtransient reactance (as with other types of machines) but the interruption requirements are based on the synchronous motor *transient reactance*. Values are given in Table I.

Practical Considerations

One effect of all of the foregoing may be to tend to make practical people shy away from the whole business of calculating fault currents and discount its importance. One may say, "Why all this bother now? We never have gone to all this trouble before and have never had any blowouts or failures or such." The answer is that either they have been fortunate in that their inadequate devices have never been called upon really to function under serious fault conditions; or that their circuits are so remote, electrically, from the generating sources that the total reactance is so high (relatively) that the short circuit currents cannot reach seriously high values.

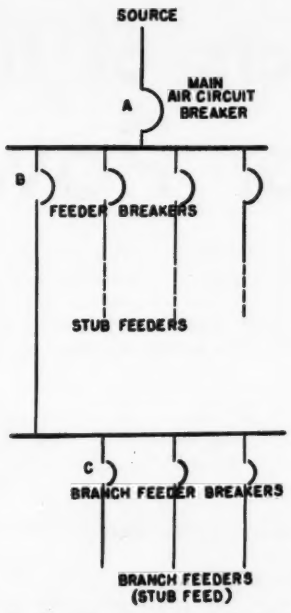


Fig. 3. Cascade arrangement of air circuit breakers

The most common application of interrupting and switching devices in industrial installations, especially of low-voltage devices, is in systems served by power transformers. In transformer secondary circuit applications, the characteristics of the system back of the transformers are not always known. It is frequently the practice to assume the transformer as the source, on the assumption that the primary voltage is maintained constant even during short circuits in the secondary.

This assumption is based on "unlimited power" available at the primary terminals and naturally results in the maximum possible short circuit current in the secondary, limited only by the transformer reactance. This is a conservative practice and may result in the selection of devices of higher interrupting capacities than may be really required.

If, however, the source of primary power is limited to such an extent that a short circuit in the secondary causes a drop in the primary voltage, it is obvious that the magnitude of short circuit current will be less than in the case of unlimited power. A convenient means for the approach to this problem is provided by the interrupting rating of the primary power circuit breaker. This information is always available even though the system characteristics back of the transformer are not known. Thus, if a power circuit breaker having an interrupting rating of 50,000 kv-a., for example, is adequate for

(*Continued on page 79*)

TABLE III
Multiplying factors and apparatus-reactance quantities to use for interrupting-device selection.

Interrupting Device	Multiplying Factor*				Reactance Quantity		
	Interrupting Capacity		Momentary Current Capacity		Synchronous Generators	Synchronous Motors and Converters	Induction Machines
	General Case†	Heavy Duty†	General Case‡	5000 Volts and Below‡			
Column No. 1	2	3	4	5	6	7	8
Fuses (15,000 volts and below, installed remote Ø from generating station or substation bus.)	1.2	..	..	1.2	Subtransient	Subtransient	Subtransient
Low-voltage Air Circuit Breakers	1.25	..	..	1.25	Subtransient	Subtransient	Subtransient
Power Circuit Breakers							
8-cycle Opening	1.0	1.1	1.6	1.4	Subtransient	¶	§
5-cycle Opening	1.1	1.2	1.6	1.4	Subtransient		
3-cycle Opening	1.2	1.3	1.6	1.4	Subtransient		

*The symmetrical short circuit current calculated as explained in the text is to be multiplied by the factors given in this table for finding the required capacity of the device to be selected.

†Where the device is to be connected in a circuit liable to short circuits of more than 500,000 kv-a., fed predominantly either directly from the generators or through current-limiting reactors only, the multiplying factors given in Column 3 should be used.

‡In circuits at 5000 v. and below, unless current is fed predominantly by directly connected synchronous machines or through current-limiting reactors only the multiplying factors given in Column 5 should be used.

¶For synchronous motor and synchronous converter symmetrical short circuit contribution the following reactance quantities should be used for power circuit breaker selection:

For interrupting capacity.....transient reactance
For momentary current capacity.....subtransient reactance

§For the interrupting capacity of power circuit breakers the short circuit contributions of induction machines are not considered; for calculating the momentary current capacity, based on the symmetrical short circuit current, the subtransient reactance is used.

Ø"Remote" means applied at sufficient distance from the generator or substation bus so that the ratio of overall reactance to overall resistance does not exceed four. Under other conditions the multiplying factor should be 1.6.

Some Aspects of the Outdoor Power Plant

To combat problems of outdoor service, steam generators and their auxiliaries are weatherproofed by various methods. Operating personnel is protected. Turbine-generators, in special housings, are handled by outdoor gantry cranes, turbine auxiliaries being placed under the turbine deck. Outdoor plants may be given a pleasing appearance. All these things can be done with a saving of materials and labor. Development is sure to continue

By Robert Henderson Emerick

Lieutenant-Commander, U.S.N.R.

THE IDEA OF the outdoor power plant suggests a saving in material, in time of construction, and in dollars of investment. It also suggests increased maintenance, exposure of personnel, and an architectural appearance that no one will like.

The major units of a steam power plant subject to outdoor location are the steam generators and the electric generators, and for each of these current practice has developed separate treatments. How these treatments combat the disadvantages of outdoor service will be discussed in turn.

The Outdoor Steam Generator

There appears to be some confusion as to what precisely constitutes an outdoor steam generator. Partially exposed boilers, which currently provide the bulk of the unhoused designs, are being described as both "outdoor" and "semi-outdoor" installations. However, the degree of exposure at which the "semi" ends and the "outdoor" begins, seems to be nowhere clearly marked. One prominent member of the American Boiler Manufacturers Association has said recently that "80 per cent of the so-called outdoor boilers are erected with the top outdoors and the rest housed in." The inference of this statement is that boilers with only their tops exposed are not truly outdoor units, despite the considerable exposure of their upper sections.

This confusion of description can be avoided if we drop the use of "outdoor" and "semi-outdoor" and in their place view the boilers as "unhoused" or "semi-housed." Housing, by immemorial precedent, concedes the presence of an overall roof, and by this standard the 80 per cent referred to above are decidedly unhoused. "Semi-housed" then describes those units which have a roof, but little or no protection in the form of wall enclosures.

Actually, boilers need no housing whatever for their own protection, and the sheds, lean-tos and similar structures frequently present on the sides of an unhoused unit serve and benefit the operating personnel solely. These little shelters give evidence that human efficiency is not enhanced by the acquisition of frost-bitten feet nor by the continuous dribble of rain against an exposed neck.

Unhoused boilers which provide no supplementary protection for the operators are not uncommon in oil refineries, chemical plants and even city gas works but, in general, these units are not basic components of the plant and their operation is either intermittent or largely unattended.

The weatherproofing of unhoused boilers is not at all diffi-

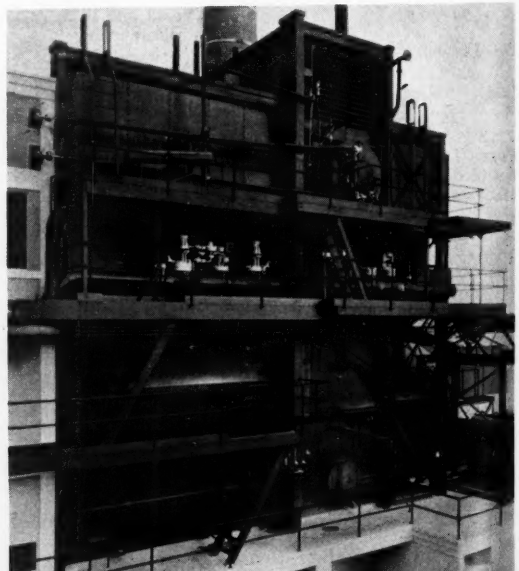


Fig. 1. A Type VU-X steam generating unit, 300,000 lb. per hr. capacity, exposed on three sides, with oil firing equipment accessible from inside adjacent turbine room; auxiliaries in open; note enclosure with louvers provided over upper boiler drum. Walkways provide full accessibility for normal operation and for maintenance. Note details of breeching, piping, boiler covering. This installation is a good example of the compact, pleasing appearance that is possible in a well-designed outdoor installation

Photo courtesy of Combustion Engineering Co.

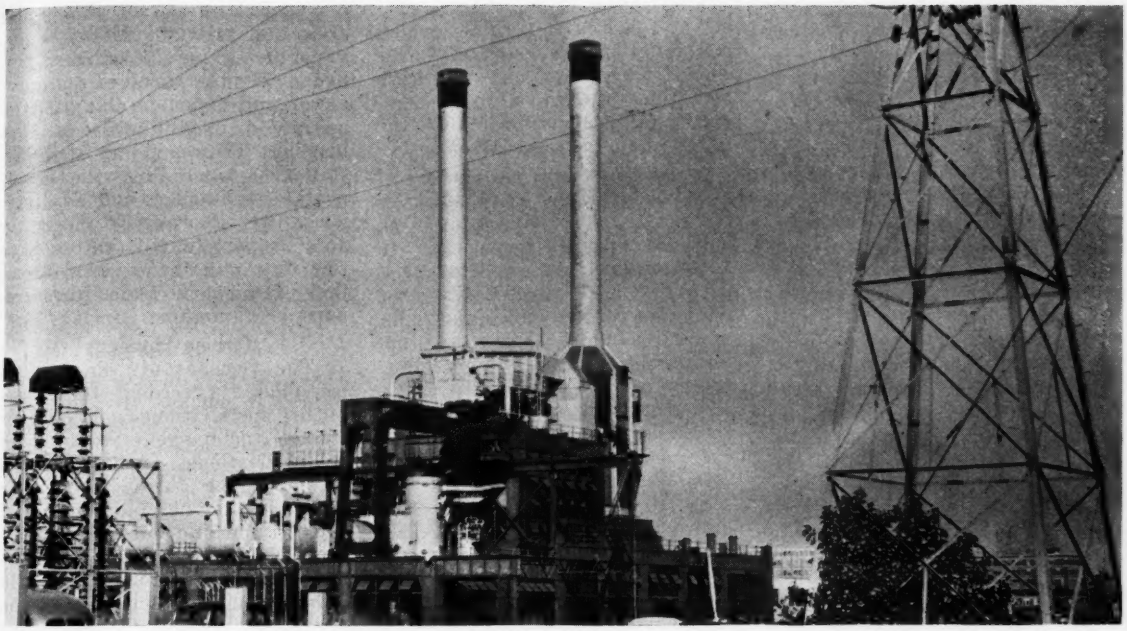


Photo courtesy of General Electric Co.

Fig. 2. A new view of the famous 20,000-kw. mercury-vapor power plant, showing the turbine deck, mercury boilers, gantry crane and enclosed lower portion containing auxiliaries and centralized control equipment

cult. Locomotive designers solved the problem for their own highly special conditions years ago. A typical plan for stationary boilers will employ 9 in. of brick wall, 4½ in. of insulating brick, and a sealing envelope, or casing, of No. 12 BWG steel plate. The casing is fabricated of removable panels, with their joints made tight by the use of battens. Use of this casing is, of course, not obligatory. Probably half of the unhoused boilers are erected without it but, in these instances, the porosity of the brick setting is ordinarily sealed up with a filler and waterproof paint.

There now remains the job of weatherproofing the boiler top. For this important surface, several inches of concrete will give satisfactory results. Some designers prefer sheet metal to the concrete and this, too, is quite adequate.

Air and gas ducts, if present, are usually weatherproofed with a light-weight sheet metal lagging, laid on with watertight seams, thus protecting conventional, blanket-type insulation.

Protection of the operating personnel, when provided, appears in a variety of forms. Most common and most inexpensive, is a small shed or lean-to, built out from the front of the boiler, and dimensioned to permit normal attention, adjustments and even minor repairs to the firing equipment. Corrugated iron is the most often chosen material and the resultant structure, although not beautiful, appears to serve most adequately.

If several boilers make up the installation and there exists a firing aisle which serves the entire battery, this aisle can be enclosed quite simply by extending each shed, or lean-to, into the one next adjacent. The resultant cloister gives the operators, in effect, a snug control hall from which the steam generators are observed and conveniently attended.

It is thought desirable by some engineers to erect covering structures over walkways, ladders and platforms, but these box-like creations are, more often than otherwise, of painfully ungainly appearance. Wherever conditions permit, this writer favors the use of remote controls actuated from the operators enclosure, not only to achieve a better appearance but also to secure prompter operating attention as well.

Semi-housed boilers are frequently so designed that a canopy roof is carried on extensions to the boiler steel, thus making an inexpensive shelter for auxiliary equipment which the designer may desire to locate above the boiler. Asbestos covered corrugated metal of No. 18 or No. 20 BWG is thought well of for this sort of roof and a limited amount of siding of the same material may or may not be incorporated in the design. Some designers feel that siding carried down briefly from the roof is well justified by the added protection secured. Ventilation is, of course, necessary, and may involve the use of exhauster fans.

However, if little else than piping is located above the boiler, there appears to be small need for any type of roof. The piping is readily insulated against snow and rain and the cost of this insulation, plus the cost of weatherproofing the top of the boiler, are together likely to be less than the cost of a canopy roof. From the appear-

The Author

Robert Henderson Emerick, now a lieutenant-commander in the U.S.N.R. on active service outside the U.S., has had wide experience in the design and operation of outdoor power plants. He served for a number of years with the Philadelphia Steam Co., then as a mechanical engineer for Phoenix Engineering Co. (Electric Bond & Share Co.) where he had close contact with outdoor plant design and installation. Later he was in charge of boiler sales in New England for Henry Vogt Machine Co.

ance viewpoint, a steam generator with its top and piping weatherproofed may be easier on the eyes than is a weatherbeaten umbrella of corrugated iron.' It must be remembered, also, that a boiler canopy, high in the air, is of no protection whatever to the operating crew on the ground. An operators' shed is likely to be quite as necessary as though the canopy did not exist.

A problem of design that occasionally arises when space is scarce is this: Can a boiler be so installed that one or more of the setting walls serves as part of the outside walls of the building? The answer is, of course, affirmative. It has been done. However, there is a tendency for the exposed walls to crack, as the unequal temperatures cause extreme and uneven stresses. In several such installations observed by the writer, these cracks were serious enough to allow warping and burning of the boiler steel.

In general, this kind of semi-housed boiler might be better avoided. If no other plan is practicable, then the inclusion of expansion joints, strategically located in the composite walls, appears to be an obvious precaution.

Outdoor Turbine Generators

Outdoor installations of turbine generators are not yet common. About ten years ago the General Electric Company at Schenectady, New York, began the operation of an outdoor 20,000-kw. mercury turbine, which has functioned successfully ever since. This unit may not have been the first outdoor turbine-generator, but it does appear to be the initial one of substantial size.

Severe Climates No Barrier

A severe climate is no barrier to the satisfactory operation of an outdoor turbine-generator. In Schenectady, winters bring temperatures of 30 deg. below zero, with heavy snow and high winds, while in summer, 95 deg. F. is not uncommon and rain storms, accompanied by wind and lightning, are frequently severe and sometimes destructive. Despite these extreme conditions, the design has satisfactorily safeguarded the physical well-being of both men and machinery.

As most engineers know, the mercury-steam process includes a mercury-vapor generator, a mercury-vapor turbine-generator, a mercury-vapor condenser in which the circulating water becomes steam under pressure, a steam turbine-generator operating on steam from the mercury-vapor condenser, and finally, if the steam turbine operates condensing, a steam condenser of conventional type. At Schenectady, the mercury-vapor condenser is considered to be, actually, a steam boiler, and both the top of this boiler and the top of the mercury-vapor generator are entirely outdoors. The two turbines, mercury-vapor and steam, are located on an outdoor deck, likewise without housing. The remainder of the installation, including the lower parts of the boilers and all auxiliaries, are thoroughly closed in and, as the plant operators have few duties in the exposed areas, they face very little inconvenience or discomfort.

Turbine Housings

The Schenectady design has provided a precedent for subsequent installations of outdoor steam turbine-generators, with local variations. One variation is to cover the turbine generator with a liftable box-like housing of steel frame and siding construction. Inside dimensions of the housing are generous enough to allow all normal activities of the operating personnel and even minor repairs. If major repairs become necessary, such as lifting the turbine casing, or rotor, the gantry crane, which travels along the open deck, is used to remove the whole housing as a piece. It is not unusual to build the box with a liftable roof, thus permitting semi-major repairs or access without disturbance to the main body of the housing.

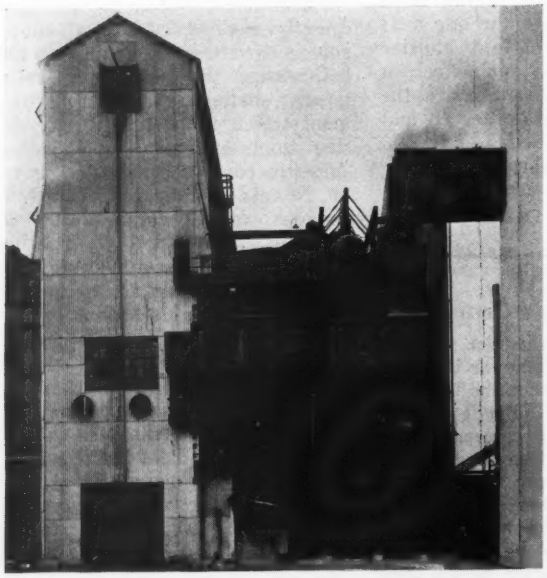


Photo courtesy of Riley Stoker Corp.

Fig. 3. An outdoor steam generating unit, capacity 125,000 lb. per hr., 700 psi., 750 deg. F. fired by pulverized coal and oil, installed adjacent to an existing oil refinery boiler plant, the firing aisle of which was extended to serve the new unit

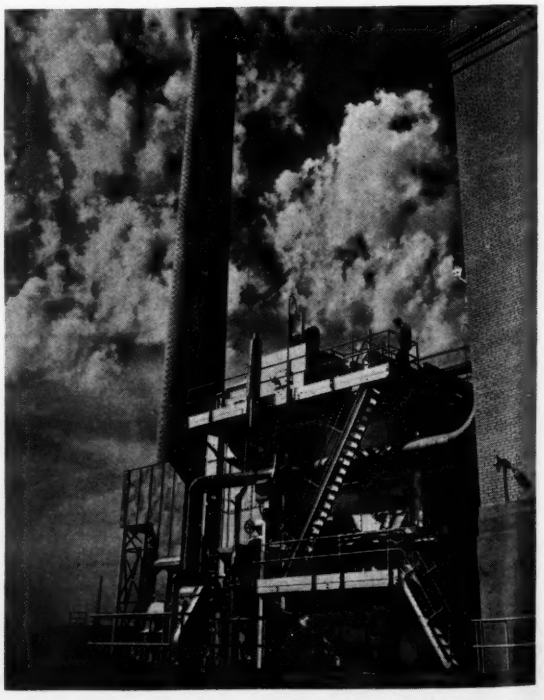


Photo courtesy of The Babcock & Wilcox Co.

Fig. 4. One of two outdoor units at a central station; capacity 200,000 lb. per hr. each, 750 psi, 830 deg. F., fired with gas and oil

The use of the term "outdoor" is not actually correct in describing installations of this type, for the machine is snugly housed from winds and falling weather. Perhaps it would be more nearly accurate to view such a unit as operating in an outdoor turbine hall and under the shield of a removable cover. Regardless of what we call it, the design illustrates an interesting and working method for saving material, time, and space.

Outdoor Auxiliaries

Condensers and auxiliaries, in common with turbine generators, can be readily weatherproofed. However, surface and jet condensers, because of the generally desirable practice of locating them underneath the turbines they serve, automatically gain considerable protection from the turbine deck. In layouts of this sort, the turbine deck becomes a roof, and walls accrue naturally as the result of excavating for the condenser basement. Barometric condensers, of course, have been erected outdoors for years.

A variant design which avoids excavation, is to build an elevated deck so that the location of the turbine generator is tantamount to being on the roof. In these cases, the condenser and auxiliaries can be inexpensively housed, simply by closing in the supporting columns of the deck. This housing appears desirable, due to the considerable attention that must be given to feed pumps, evaporators and other auxiliaries, especially in a modern plant having an elaborate heat balance.

Treatment of the turbine crane is interesting. At Glendale, Calif., the turbine is housed in a box-like liftable structure of steel. The crane, straddling this structure, travels on rails supported by the outdoor deck. A comparable practice is observable in a plant of the Utah Power and Light Co., near Olmsted, Utah. In this plant the upper levels of the boiler are outdoors, and the turbine generator is completely housed by a permanent structure of brick. A gantry crane, straddling the permanent building, operates through removable hatches in the building roof. Net result is an obvious and substantial saving in building cost.

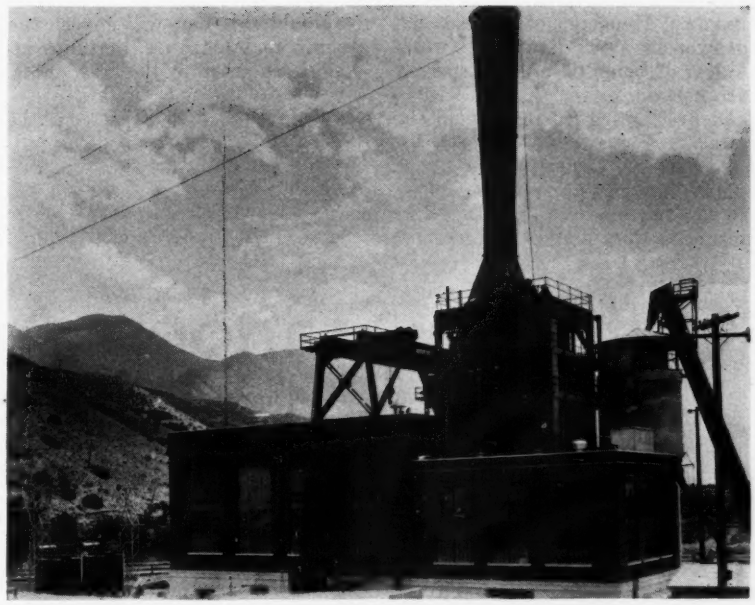


Photo courtesy of Combustion Engineering Co.

Fig. 6. An early semi-housed plant; one 18,750-kw. turbine generator in main building at left; handled by gantry crane through roof latches; one 200,000 lb. per hr., semi-housed Type VS steam generator, chain grate stoker fired; firing aisle enclosed by building at right, coal silo behind it

Architectural Considerations

In the October, 1942, issue of POWER PLANT ENGINEERING there appears an illustrated discussion of power plant architecture by Daniel A. Elliott. Municipal steam plants now operating in the cities of Glendale and Burbank, Calif., are pictured, and these plants, architecturally graceful throughout, exhibit a harmonious care in the development of their outdoor features. They are working evidence that unhoused and semi-housed installations are not ugly, nor even ungainly, by necessity.

This whole problem of satisfactory architectural treatment appears to be a problem of imagination that must be solved by cooperation of the architect and engineer. Perhaps, as interest gains in the outdoor idea and as installations increase in number, we shall witness the evolution of an original architecture, appropriate to this new concept of outdoor power. One thing seems certain: that the cost of obtaining a pleasing appearance will take but a small part of the savings otherwise accrued from an outdoor design. Weatherproofing adds about 5 per cent to the cost of a turbine generator, and perhaps 10 per cent to a steam generator, including an inexpensive operators' shed for the latter.

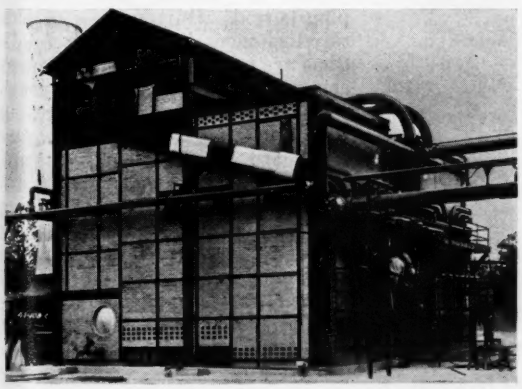


Photo courtesy of Henry Vogt Machine Co., Inc.

Fig. 5. Two outdoor steam-generating units, 1035 hp. each serving an oil refinery. Typical of oil refinery practice for many years. Note pipe protection, roof over boiler drums only, venturi stack

The War Factor

Beyond doubt, unhoused and semi-housed power plants possess an increased susceptibility to damage from bombs. Fragments from a "near miss" which might be deflected or at least retarded by iron or masonry walls, could conceivably disrupt a boiler or turbine generator beyond immediate use or

repair. Housing, of course, has drawbacks also. Roofs and walls, unless of bomb-proof construction, are certain to increase the debris and fire hazard during a bombing attack.

However, protection for power plants in areas potentially exposed to war damage is best obtained by installing the plants underground. No doubt this fact will govern the design, in the future, of those installations vital to the war effort.

Summing Up

Engineers embarking on the design and construction of an outdoor power plant have several successful precedents of varying degrees of exposure from which to choose. The problems of personnel protection and of machinery preservation, under all conditions of weather, have been solved in various ways. Material and labor savings can be realized in substantial measure, the maximum, of course, being obtained from total exposure.

In view of these facts, development is sure to continue.

Outdoor Stations Are Simpler

A short discussion of the factors involved in modern generating station design and construction with special emphasis on the possibilities of outdoor types of construction. Supervisory instruments of the remote-reading type developed in recent years have increased the possibilities of effective outdoor types of design

By R. L. REYNOLDS, Turbine Design Engineer, Westinghouse Elec. & Mfg. Co., South Philadelphia, Pa.

CONSTRUCTION of outdoor steam turbine generating plants have been gradually undergoing a change from the public library style to a less costly type involving no sacrifice in utility. Several operating companies have built stations of the machine shop type and a few have proceeded even further and built stations with the upper half of the boilers, including the induced draft fans, exposed to the weather. Other kinds of electrical equipment, notably transformers and synchronous condensers, have been almost completely exposed to the weather.

In contemplated simplifications in the construction of steam turbine generating stations these three types might be considered:

(1) A completely outdoor station in which all equipment is exposed to the weather, with control instruments of the weatherproof type. With this construction, such equipment as turning gear-motors, speed-changer motors and electrical switches must also be of the weatherproof type.

(2) A semi-outdoor station in which the turbine-generator and exciter are exposed to the weather, but condenser and condenser auxiliaries are protected by the turbine room floor, and with control instruments in a separate operating room. This is shown in Fig. 1.

(3) A station in which the turbine-generator unit is protected from the elements by being housed in a double-wall sheet metal structure. This is shown in Fig. 2.

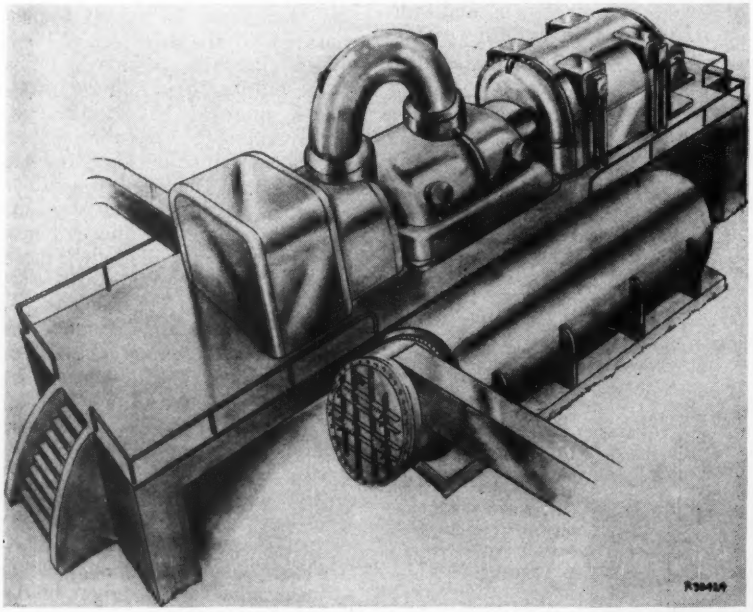


Fig. 1. A semi-outdoor station might look like this, with the turbine-generator and exciter exposed to the weather; condenser and condenser auxiliaries protected by turbine room floor. The condenser shown is of the twin type to reduce the height of the foundation. A conventional type of condenser can be used if desired

Chief objections to an outdoor station come from operators, who must at all times know how the turbine-generator unit is performing and, where necessary, make adjustments to improve this performance. Supply of power to the electrical consumer must be absolutely dependable and no reasonable expense should be spared to maintain this dependability. Therefore, in order to make the outdoor station practical, means must be provided to enable the operator to make a continuous check of all important phases of operation and to correct any condition which might cause trouble.

There are two critical periods in the operation of a turbine-generator; the starting and the stopping periods. During these periods rapid changes in operating conditions are taking place and frequent observations must be made to make sure the unit is in proper operating condition. Of particular importance are measurements of shaft outage, cylinder expansions, vibration, speed, vacuum and bearing oil temperatures. Also, during these periods, it is necessary to start or stop condenser auxiliaries, air removal equipment and auxiliary oil pumps, and cut feedwater heaters in or out of service.

After the unit is placed on the line and all feed-heating equipment

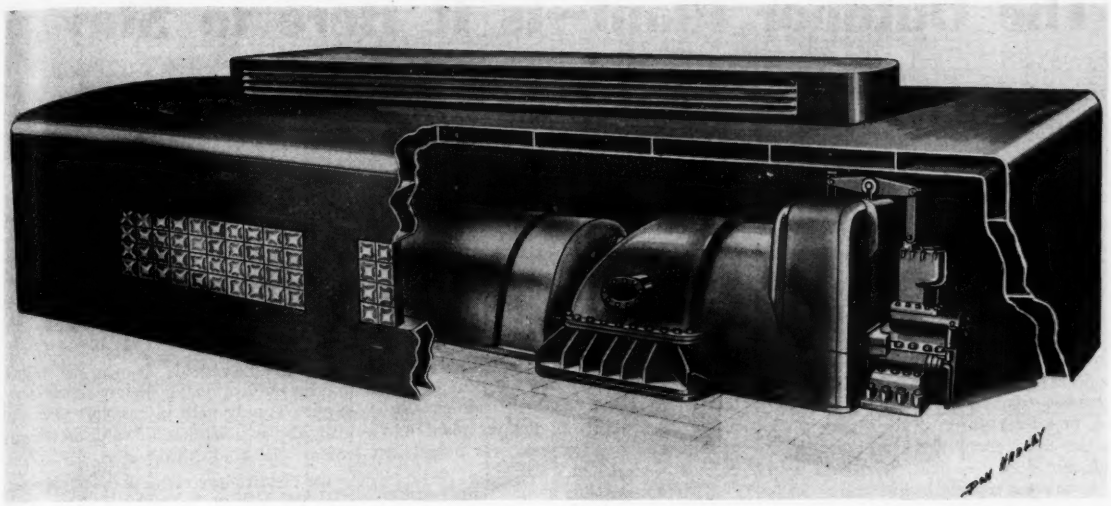


Fig. 2. For cold climates the turbine-generator unit can be protected by a double walled sheet metal structure

is placed in service, less frequent observations are required. Of chief importance during this normal operation are observations of steam conditions, cylinder expansions and contractions with changes in load, governor operation, vibration and bearing oil temperatures.

To assist the operator in checking the condition of the unit, supervisory instruments of the remote-reading type have been developed for observing the following conditions:

SHAFT ECCENTRICITY. For direct reading the outage of the shaft is shown on a dial indicator. For remote reading, the outage is sensed electrically and can be recorded and thus keep the operator informed regarding the behavior of the shaft.

BEARING TEMPERATURES. Thermometers or thermocouples measure temperature of oil leaving the journal and thrust bearings. These thermometers may be equipped with alarm contacts to warn the operator if temperatures become dangerously high.

VIBRATION. Vibrometers of the magnetic-pickup type measure the vibration at critical points of the unit. The indicating and recording instruments located in the control room warn the operator of any undue increase in these vibrations.

EXPANSION METERS. This meter, by means of synchronic motors, indicates and records the expansion and contraction of the cylinder with changes in load. It is important that this expansion should take place uniformly without sticking between the sliding pedestals and stationary soleplates.

INTERFERENCE. A position indicator measures the axial movement of the turbine rotor and thus indicates the axial clearances between the stationary and rotating elements. This indicator is equipped with an alarm contact to warn the operator if any undue movement occurs. In addition, the indicator can be equipped with a second contact to trip the throttle valve shut in case the axial movement progressed to the point that danger of interference between stationary and rotating elements becomes imminent.

SOLENOID TRIP. This trip is a conventional piece of control equipment whereby the turbine stop valve can be tripped shut from the control room.

TACHOMETER. A tachometer actuated by electric means can be equipped with an indicator and recorder in the control room. This instrument is of particular importance during starting and stopping periods and it is accordingly necessary either to have another instrument at the turbine, or to locate the control room so that the tachometer chart can be seen from the operating floor.

PRESSURE GAGES. Gages for measuring steam and oil pressures would be installed on the control room board. Gages required for starting must either be so located that they can be seen from the operating floor, or duplicate gages must be installed at the turbine.

In addition to operating problems, another factor to consider is that of dismantling for inspection or repair. For northern climates, subject to snow and cold, a repair program on an outdoor unit presents severe difficulties. Also, provision must be made against freezing of water lines and congealing of oil in pipes and reservoirs. Thus, it does not appear wise to expose the unit to the elements in those sections of the country having severe winters.

Another type of construction can be used in the cold climates, in which the turbine-generator unit is housed in a double wall sheet metal house. The space between these two walls would serve as a duct for air-conditioning in order to make the room bearable on hot summer days. Such a house would not be expensive and would offer ample protection for necessary repairs. A single-rail hoist running longitudinally along the centerline of the unit would permit lifting the bearing housing covers and other parts for inspection and for minor repairs. For major repairs, the roof of the house could be lifted and the parts handled by an outside gantry crane.

Although an outdoor station involves some operating difficulties, introduces problems in inspection and repair, and requires additional supervisory equipment, there is no question that this type of construction materially reduces the cost of the station without sacrificing reliability. In those sections of the country where weather conditions are favorable, this reduction in cost justifies the additional operating difficulties. In other sections, subject to more severe changes in weather conditions, a modified outdoor construction with the turbine-generator unit protected from the elements by a relatively cheap housing appears to be the logical solution.

The Outdoor Plant—Is It Here to Stay?

By Chester R. Earle, ***Associate Editor***

HOW about maintenance on that fan outdoors in the rain? What if a sudden cold snap freezes up the connections to water columns and feedwater regulators? When you get the cover off that outdoor turbine and the rotor out and everything disassembled for overhaul, what are you going to do with the pieces? Leave them out on the deck where corrosion will start within a matter of hours? How would you like to adjust safety valves and work on the non-return valve of that boiler with no roof on it? What do you do to prevent trouble in instrument leads that are partly indoors and partly outdoors? Would a water column outdoors be more or less trouble?

You'd certainly eliminate some hot, uncomfortable working spaces, replacing them possibly with well-refrigerated or humidified locations. Also, in view of the WPB motor conservation order, you would have a different auxiliary motor problem. Especially on fan motors, you wouldn't have the high ambient temperatures to take account of. Would that be balanced by new troubles? And there'd certainly be plenty of room to handle boiler tubes, lances and tube cleaners. True, weatherproofing and protective housings would make it harder to get at some of the equipment in a hurry.

These questions and comments are, almost verbatim, the sort of thing we hear frequently nowadays when outdoor plants are mentioned—and even when they aren't!

For the outdoor plant has been pushed very much into the spotlight. The fact that a number of outdoor plants have been erected during the past 12 yr. has led to much discussion of the possibility of diverting labor and materials, especially steel, into the armament program by designing power plants without the buildings.

The outdoor plant is by no means a new idea. In an editorial on Outdoor Power Stations on page 432 of the April 1, 1931, issue of POWER PLANT ENGINEERING, we referred to plans for the G-E outdoor mercury plant and for a 1400-lb. outdoor steam station in the Far West. We commented on the number of existing and projected outdoor hydro-electric generators, on oil refinery practice, on synchronous condensers and electrical equipment outdoors, on centralization of control and protection of the operating personnel. Finally, we urged the scoffers to go easy with their hoots of derisive laughter until they had done some very careful investigating.

There was much opposition to the idea at that time. There is still much opposition to it on the part of many leading designers, whose careful investigation of both investment and operating costs convinces them that it is very hard to justify, especially in the colder climates. Nevertheless, many unhoused and semi-housed plants have been built in all sections of the country since 1931.

Investment savings are hotly argued. For one semi-housed plant, investment savings of $6 per kilowatt have been given as compared with a fully-housed station. For another semi-housed plant, a saving of nearly 10 per cent of the total station cost has been claimed. But in wartime, ability to get the plant into operation in time to serve war industries is equally vital.

It is not possible at this time, because of the censorship regulations, to give a complete list of the outdoor steam stations and their locations. One engineering organization in the last 12 yr. has designed at least 12 such stations, most of which are in operation, one or two now under construction. Another organization, recently faced with delays in obtaining steel for two important war power plants, designed them as unhoused plants. Still another organization has three semi-housed plants in a utility-industrial pool. A number of oil refineries have large outdoor steam and power installations. Two municipal plants have outdoor turbines.

The good appearance of these two municipal plants brings up this point: What is it worth, in terms of public relations, to have an imposing-looking power plant building, of fine architectural style, that people can point to with pride? Also, how much still needs to be done to make the totally unhoused plant look truly functional, hence architecturally sound?

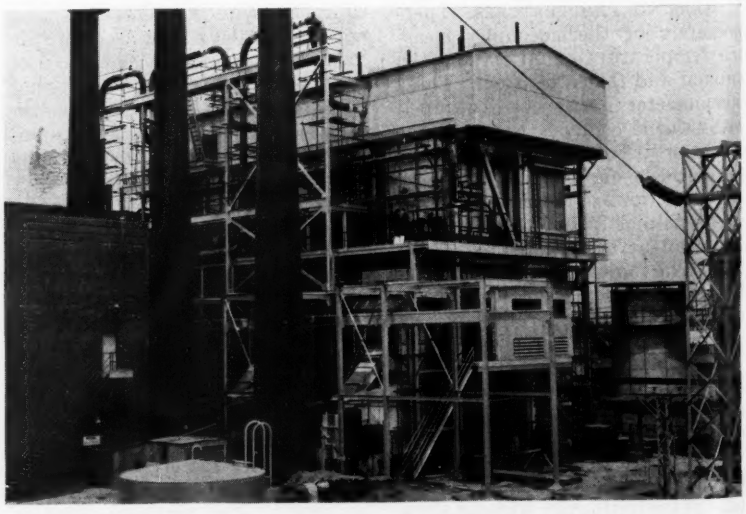
What are the possibilities of outdoor industrial power plants? Here, very often, the existing power plant building may be a part of the manufacturing plant. When speed in adding capacity is required, or a new plant needed, outdoor construction should certainly be investigated.

As in other fields, it may be found that an outdoor plant, designed primarily to give speedy help in carrying the war load, also has features of value in normal commercial competition.

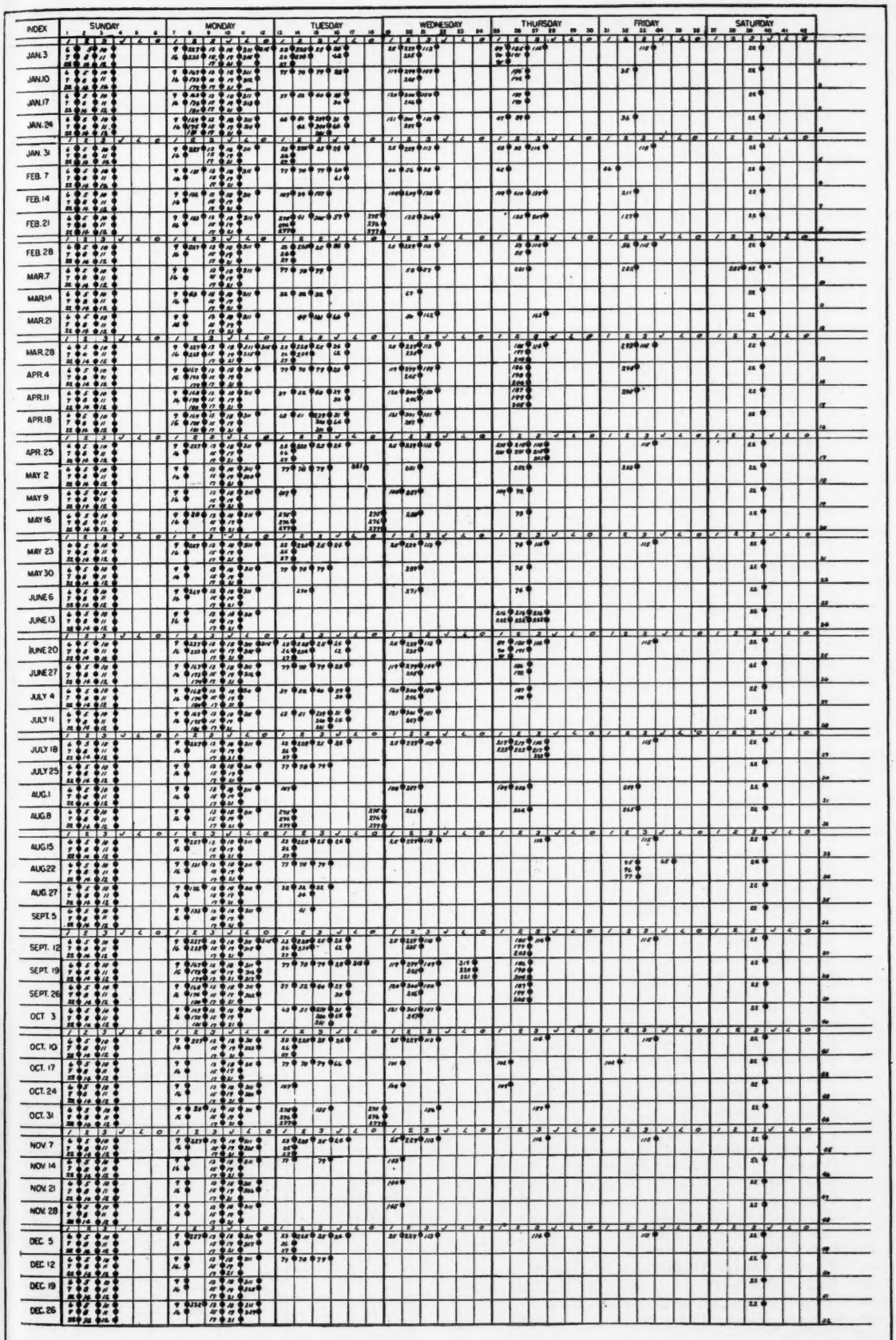
In the two preceding articles, Messrs. Emerick and Reynolds have given many interesting details of outdoor plant design.* They both indicate that this type of plant offers many possibilities for the future. This writer agrees with them.

Now, what do YOU think? For a letter of not over 1000 words on the subject of The Outdoor Power Plant that presents, in the opinion of the editors of POWER PLANT ENGINEERING, the best discussion of the various factors involved, the editors will award a $25 U.S. Savings Bond, Series E—a War Savings Bond. One condition is that your letter must reach this office not later than June 1, 1943. Never mind whether you are favorable to the outdoor plant idea or not. The editors will judge your letter on how well they think you discuss it, not on your conclusions. And the decision of the editors will be final.

*For details of a number of recent outdoor plants, see following articles in POWER PLANT ENGINEERING: California Goes Modern, Sept., 1940; P. G. & E. Solves Industrial Problem, Oct., 1940; Outside Boilers, May, 1941; Burbank's Modernistic Design, Dec., 1941; Extension to Cape Fear Station, Jan., 1943.



Semi-housed utility-industrial plant, burning waste products from industrial and supplying industrial and utility electricity. Three steam-generating units, 200,000 lb. per hr. capacity each, 1400 psi., 925 deg. F., semi-housed; note canopy, fans at ground level, steam and boiler feed piping. In building at left is a turbine-generator, also boiler control panels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101–106	Ross Lube Oil Coolers	MY1
107–112	Cuno Edge Filters	MQ1
113–118	Puralator Fuel Filters	M23
119–124	American Air Filters	MQ1
125–130	Waste Heat Boiler Inspection	MY2
131–136	High Pressure Fuel Pumps	MS2
137–142	Honan-Crane	MY3
143–148	Evaporative Coolers	MY1
149–154	Generator and Exciter	MQ3
155–160	Outboard Bearings	MY3
161–166	Breather Assemblies	MY3
167–172	Fuel Pressure Regulator Valves	MQ2
173–178	Fuel Injector Blocks	MQ2
179–184	High Pressure Fuel Gaskets	MQ2
185–190	Bosch Fuel Injectors	MQ2
191–196	Cylinder Inspection	MQ2
197–202	Exhaust Valves	MS2
203–208	Main Air Start Valves	MS2
209–214	Compression Tests	MY2
215–220	Overhauling	MY1, 2, 3
221–226	Cylinder Removal	MB2
227–232	Crankcase Inspection	MM2
233–238	Chain Drive Inspection	MQ2
239–244	Governor Linkage	MQ3
245–250	Air Pilot Valve Inspection	MM2
251–256	Air Starting Engine Equipment	MY2
257–262	Circulating Water Pump	MY2
263–268	Thermometers and Gauges	MY2
269–274	Lubricating Oil Pumps	MY2
275–280	Lubricating Oil Tests	MQ1
281–286	Oil and Fuel Relief Valve Inspection	MY2
287–292	600 gallon Fuel Tanks	MY2
293–298	Lube Oil Sump Tanks	MY2
299–304	Safety Alarm Clocks	MQ2
305–310	Governors	MY3
311	Tire Inspection on all vehicles	OWL
312	Trailer Inspection and Brake Adjustment	MSL
313	Diamond T Repair	MYL
314	Ford Truck Repair	MYL
315	Rubber Glove Testing	MQL, O
316	Station Transformers	MYL
317	Master Substation Transformer	MYL
318	Ops Substation Transformers	MYL
319	Red Lake Substation Transformers	MYL
320	Rindal Substation Transformers	MYL
321	Shevlin Substation Transformers	MYL
322	Ops General Electric Meter Test	MYL
323	West Underbuild G. E. Meter Test	MYL
324	East Underbuild G. E. Meter Test	MYL
325	P.K.M. G. E. Meter Test	MYL
326	Norman G. E. Meter Test	MYL
327	Red Lake G. E. Meter Test	MYL
328	Rindal G. E. Meter Test	MYL
329	Shevlin G. E. Meter Test	MYL
330	Delta Star Circuit Breaker	MYL
331	Pacific Circuit Breakers	MYL
332	Allis-Chalmers Switchboard	MY2

NO.107
NO.1 CUNO EDGE FILTERS, M-Q-1

DATE	NUMBER	DATE	NUMBER
10/17/42	43		
12/15/42	68		

Fig. 2. The Ledger sheet

Jobs numbered 1, 2, 3 and 4 above are daily tasks which the operators and janitor are expected to perform, and do not appear on the Assignment Schedule. These, however, are listed in detail on the bulletin board and serve as a daily reminder to the assignee. Included are the following:

DAILY ASSIGNMENT REMINDER

Shift No. 1

1. Sweep and clean auxiliary room floors.
2. Turn Cuno Edge Filters at 2:00 and 6:00 a.m.
3. Oil Intake and Exhaust Valves at 2:00 and 6:00 a.m.
4. Check master clock with KILO time signal at 7:00 a.m.
5. Patrol entire building and check lights, temperature and locks.
6. Date Esterline-Angus meter charts.
7. Wipe and clean Engine No. 1.
8. Clean shower and locker room.
9. Blow down air starting tanks.
10. Blow out relief valves on engines in operation.
11. Check lube oil level on all engines.
12. Check gas driven compressor.

Shift No. 2

1. Wipe and clean Engine No. 2.
2. Turn Cuno Edge Filters at 10:00 a.m. and 2:00 p.m.
3. Oil Intake and Exhaust Valves at 10:00 a.m. and 2:00 p.m.
4. Check lube oil level on all engines.
5. Refill surge tank.
6. Lubricate equipment as required.
7. Blow down Kewanee Boiler if in operation.
8. Date Esterline-Angus meter charts.
9. Check Condensate and Sump pump operation.
10. Extinguish all unnecessary lighting.

Shift No. 3

1. Sweep and clean engine room floor and mats.
2. Clean and dust engine room office.
3. Dust and polish Allis-Chalmers Switchboard.
4. Wipe and clean Engine No. 3.
5. Blow down waste heat boilers.
6. Patrol entire building and check lights, temperature and locks.
7. Replace all tools on the rack.
8. Date Esterline-Angus meter chart.
9. Turn Cuno Edge Filters at 6:00 and 10:00 p.m.
10. Oil Intake and Exhaust Valves at 6:00 and 10:00 p.m.
11. Check lube oil level and all engines.
12. Check water softener and salt supply.
13. Clarify fuel.

Janitor

1. Clean offices and furniture.
2. Clean walks and mats.
3. Clean all lavatories.
4. Check and replace supplies in engine room.
5. Outside building patrol.
6. Rearrange magazine rack in lobby.
7. Polish front door entrance.
8. Raise and lower flag.

The design of the Work Ticket for this system presented no great problems. It was generally agreed that the most desirable Job Ticket Book would be a loose-leaf notebook employing 5 in. by 8 in. sheets, for such a size and arrangement would, in most instances, provide sufficient space to outline the requirements of the average job. It would also provide a degree of flexibility which would permit additions and alterations deemed necessary or desirable from time to time.

Maintenance Report No. 189

Minnkota Power Cooperative, Inc.

GRAND FORKS, NORTH DAKOTA

Plant X Lines Building Date Oct. 22 1941

Work To Be Done Drain, clean and inspect #1 Fuel Oil Storage Tank

Reason: Scheduled Maintenance

Ordered By: Lerfald Assigned To #2 Deahr

CASE NO.	WORK COMPLETED, MATERIALS USED, AND REMARKS IN DETAIL	HOURS TIME REQUIRED	DO NOT USE THIS COLUMN
72	8073 gallons of oil transferred to Tank 3. Sludge and settings washed out using hose and broom. Approximately 6" of dirt and scum had accumulated in bottom of tank. No evidence that heater coil has been leaking indicating excess water drainings result from condensation.		
	Vasicek	4	
	Fahey	1	
	Holt	3	

FILL OUT ORIGINAL COPY ONLY. Signed: Terrance Deahr

Fig. 3. The Maintenance Report Form used in recording data in regard to work done on equipment

The numbering of the Work Tickets carry no special significance but in this instance numbers have been left blank for assignment to new equipment which it is anticipated will be installed at a later date. The contents of the Work Ticket are best drafted by following the recommendations of the manufacturer of the equipment under consideration. These recommendations are generously supplied by the manufacturer and in our instance we have built up a most valuable Equipment File from the literature which they have supplied us. For every piece of equipment we own and operate, we have literature supplied by the manufacturer. This proves to be a most valuable help, especially to our more inexperienced operators.

At the end of this article are shown typical Job Tickets in use.

The recording and filing of facts concerning mechanical and electrical work done on equipment is highly important and frequently referred to and, therefore, it was decided that the usual method of recording such information on the log sheets was inadequate and undesirable and should therefore be abandoned. In its stead, the Maintenance Report Form shown on Fig. 3 was adopted. This particular form is also used for the assignment of special maintenance jobs which may occur from time to time.

Supporting this Maintenance Report Form, is the Ledger Sheet shown in Fig. 2. This ledger has one sheet for each job number and has provisions for recording the date and number of any Maintenance Report used in recording work done on the corresponding equipment. In this manner the complete maintenance history of any piece of equipment may be easily and quickly secured by first referring to the Index Ledger and then looking up the Maintenance Reports which were found to be listed thereunder. Provisions have also been made to record work that it was found impractical to schedule. These would include such items as Honan-Crane and Briggs cartridge replacements which are difficult to schedule for a given date.

Although the above system has been in operation but a few months at the Minnkota, it has already paid dividends which far outweigh the time and study given to its development. Specific examples of these dividends include

(*Continued on page* 130)

The Power Industry at War

Vital role of power in the war, the fact that the power industry has effectively met all the war demands made upon it and technical details of maintaining the vital power services in the face of serious shortages of labor and materials were emphasized at the Midwest Power Conference at Palmer House, Chicago, Ill., on April 8 and 9.

GENERAL RELATIONS of steam and electric power to war production were brought out in considerable detail at the opening meeting on April 8 under the chairmanship of H. O. Croft of the State University of Iowa. In an address of welcome, H. B. Gear, vice president, Commonwealth Edison Co., reviewed briefly the history of the country's power plant developments over the past few years, showing the industry had been successful in carrying the loads imposed upon it by the preparations for war.

Fig. 1. Speakers at opening meeting, Midwest Power Conference, April 8, 1943. Left to right: H. B. Gear, H. O. Croft, C. W. Kellogg, M. P. Cleghorn, Philip W. Swain, Stanton E. Winston

Replying for the co-operating institutions to Mr. Gear's welcome, M. P. Cleghorn of Iowa State College summarized some of the problems faced by the industry.

The paradox of the increase in total power load of about 15 per cent in two years while a ten-fold increase has been occurring in war production was analyzed by C. W. Kellogg, president of the Edison Electric Institute in his paper on Electric Power Supply at the opening session on April 8. An abstract of this paper appears on page 57 of this issue, the What Leaders Say page.

Papers on Breaking Bottlenecks in Piping Materials by G. W. Hauck of Crane Co., and Boiler Maintenance Under War-Time Conditions by A. C. Foster of Foster Wheeler Corp. appear in this issue. Effect of Coal Sizing on Efficiency and Operation of Mechanical Stokers by Otto de Lorenzi of Combustion Engineering Co., will be published in the next issue.

Turbine Blade Deposits

Turbine Blade Deposits was the subject of a paper by Frederick G. Straub of the University of Illinois at the afternoon session on April 8 under the chairmanship of R. K. Behr. Professor Straub reviewed the studies made several years ago that resulted in the wide use of sodium sulfate treatment in the boiler water to prevent turbine blade deposits, with good results in many cases. In recent years, a new type of deposit on turbine blades, consisting mostly of non-water soluble silica, SiO_2, has been encountered, predominately in the 400 to 550 deg. F. temperature range of the turbine. Selective deposition appears to make untenable the theory of a bonding material being necessary for blade deposits, said Professor Straub.

He then reviewed briefly the main theories that have been advanced to explain turbine blade deposits. These are: the carry-over theory; the evaporation theory, and the solubility theory, which considers that steam at higher pressure does not behave as a perfect gas but actually dissolves salts present in boiler water. The salts have less solubility in the steam than in the water but at high pressures are of sufficient magnitude to cause blade deposits. Professor Straub gave a brief summary of the data available on turbine blade deposits, indicating that:

1. The insoluble silica deposits form in the temperature range between 400 and 550 deg. F.

2. The amount of silica deposits are not directly related to the soluble silica content of the boiler water.

3. It is possible that a proper conditioning of the silica in the boiler water might reduce the silica deposits in the turbine.

In concluding, Professor Straub showed how introduction of magnesium sulfate, $MgSO_4$, in one case caused the silica in the steam to drop to a very low value and said that might explain why there is silica trouble in some plants, none in others.

Conversion from Oil to Coal

In converting small heating installations and large commercial and industrial steam generators from oil to coal burning, such fac-

(*Continued on Page* 110)

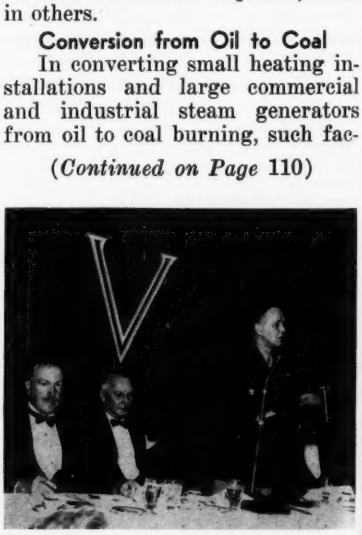

Fig. 2. Maj.-Gen. Henry S. Aurand, Commanding General, 6th Service Command, addressing All-Engineers Dinner, Midwest Power Conference, April 8, 1943, and presenting the speaker (at left) Col. James L. Walsh. In center, Toastmaster James D. Cunningham

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

POWER FACTOR FOR THE BUSINESS EXECUTIVE

Here it is at long last! The truth about "power factor" in terms a business executive can understand—we hope. In a recent editorial in "Fortune" we find—"One of the peculiarities of alternating current is that it divides itself into active and reactive energy components. If the energy is used to drive machines and light lamps, it is active, the power factor approaches 100 per cent, and it can be measured in kilowatts. But if it is used to excite transformers, charge induction motors, or in any other magnetic-field application, it is reactive, the power factor approaches zero, and it cannot be measured in kilowatts, but rather in kilovars (which is electrical shorthand for 'kilovolts-amperes-reactive')." Neat and snappy, hey what? Something every tycoon can understand without having to ask some third assistant what cos. ϕ stands for. Note, that we don't beat around the bush, so to speak, we get right into "kilovars." Most of us poor dopes who have been in the game a quarter of a century are not sure that we know what a reactive component is, we are still trying to picture in our minds a "wattless current" but our illustrious contemporary feeds the business exec. kilovars right off the bat. The world do move! In the same editorial it tells about 2300 lb., 940 deg. steam which heats the turbine buckets of the "monster" turbine at South Bend "to a *cherry-red* color as they whirl around at a peripheral speed of 600 to 700 miles per hour." The italics are ours.

A.W.K.

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A Section of Power Plant Engineering Devoted to PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago, Ill.

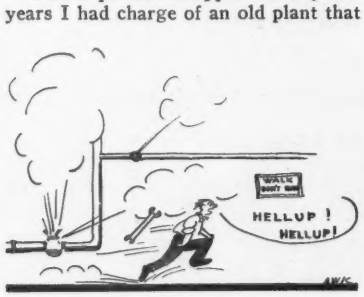
Hair-Raising Refrigerating Experiences

Brother Malarkey started something with his article, "Refrigeration Don'ts" in the November, 1942, issue. First, in the February issue, George Holman is reminded of a number of almost grewsome incidents in his career and now, comes Mr. Baker with more exciting experiences. They are really hair-raising.

By ROBERT BAKER

THE INTERESTING ARTICLE by George Holman which appeared on page 96 of the February issue brings to my mind some similar but none too happy experiences in my own career as an operating engineer.

For a period of approximately ten years I had charge of an old plant that



He Beat It.

has since been taken over by my present employers. The ammonia equipment in this plant was of ancient vintage and was far from being in the pink of condition. Perhaps, I should say, the entire refrigeration system because some of the brine lines were so rotten that just to hang a pipe wrench on them was inviting disaster. Coatings of ice would cause them to drop.

The two highlights of my career in that plant were concerned with the high side ammonia lines. There was a header in one corner of the engine room in a none too accessible location. From this header ran several lines all of which were 2-in. pipes. On the particular night when the incident related here occurred, I asked the oiler on duty to close the valve in one of the headers. This he did, but I did not tell him to use a wrench on the valve. When he put the wrench on that valve and gave it that extra twist for good measure, he immediately wished he hadn't, and so did I.

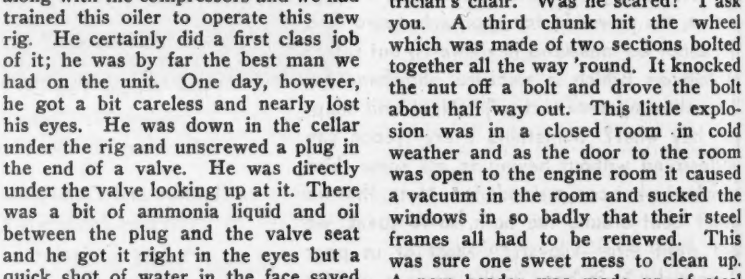
He twisted the whole bonnet off. There was about 125 lb. pressure on that line and it was a *liquid* line. The oiler was directly in front of the valve and when the top came off he let out a yell that I can still hear. Then he beat it. I had to shut off the valve on each side of the wrecked valve at different parts of the plant. Lucky for him that he was not permanently injured. He never used a wrench on a valve. It was a bitter experience but it taught him a lesson. The valve in question was a four bolted bonnet valve so the damage done can be imagined. The accident was of course partly his fault and partly that of the valve being old.

This same oiler pulled off another stunt one day that might have turned out much more seriously than it actually did. We had installed a double-unit Vogt absorption machine to run along with the compressors and we had trained this oiler to operate this new rig. He certainly did a first class job of it; he was by far the best man we had on the unit. One day, however, he got a bit careless and nearly lost his eyes. He was down in the cellar under the rig and unscrewed a plug in the end of a valve. He was directly under the valve looking up at it. There was a bit of ammonia liquid and oil between the plug and the valve seat and he got it right in the eyes but a quick shot of water in the face saved him. The last I heard of him he was with my company in their Detroit plant as engineer. He was one of the few really decent lads who could be taught to use his head and I hope he goes a long way on the engineering road.

In another case where I was not present when the trouble happened but came in to relieve the engineer on watch, I got the mess to straighten out. Here we had a big Arctic horizontal double acting electric driven machine. The motor was a 500 hp. job so, it will be obvious that the machine was no peewee. It had two cylinders with the wheel between the cranks and it was belted to the motor which was set behind the cylinder heads to save room.

On the day in question, the day gang started this unit up and had scarcely got it under way full speed when one of the discharge headers on the cylinder let go. This machine, as those familiar with it may know, takes the gas in at the top and discharges it at the bottom, uniflow style, the suction valves being in the ends of the pistons. Whether the metal was crystallized or what happened, nobody knows, but the header let go and shot out through a door. It took several stud bolts off the rim of a cross compound engine that was open for overhaul, then flew across the engine room at such an angle that it just missed an ammonia receiver and knocked a casing off a door before it finally stopped. This piece was the major portion of the header. Another smaller chunk went through the belt and hit the ceiling right under the electric shop overhead, directly under the chief electrician's chair. Was he scared? I ask you. A third chunk hit the wheel which was made of two sections bolted together all the way 'round. It knocked the nut off a bolt and drove the bolt about half way out. This little explosion was in a closed room in cold weather and as the door to the room was open to the engine room it caused a vacuum in the room and sucked the windows in so badly that their steel frames all had to be renewed. This was sure one sweet mess to clean up. A new header was made up of steel pipe extra heavy and all turns welded. When the plant was torn down several years ago it was still in place.

On still another occasion I was carried out of that same plant when an elbow on that same machine let go on my watch. I went upstairs above



It took several stud bolts off a cross compound engine on its way out

the aforementioned cross compound compressor to close two valves from the wrecked header and when I came down the gas was coming out the door to the Arctic and got me. That is once my wife had it all her own way for I could not speak out loud for nearly two weeks.

I have often charged ammonia into the suction of a compressor but don't like it as well as charging into the system.

I can beat Mr. Holman as to scars on my hands. First three fingers right hand have been smashed and the ends nearly cut off but they are still all here yet and in good working order. Little finger has a buzz saw scar the entire length inside caused by fooling with my uncle's buzz saw when he told me not to, when I was a kid about seven or eight years old.

Many years before I hit this town I was engineer in a creamery in Syracuse, N. Y. This plant had one boiler in a sort of sub-basement. We burned hard coal with forced draft. The ice machines were in a separate cellar at the other end of the plant and that is why I am alive today. This plant was run seven days a week making ice cream and other milk products. Never any time out for boiler wash or inspection. The owners would not get another boiler till after the accident I am about to relate. In some way it is still funny to me. This was an hrt boiler with the combustion chamber to the back of the boiler room but right near the cleanout door was a men's toilet. The day in question will live forever in my memory. And how! The trouble was caused from neglect of the owners to give the chief engineer a chance to wash boiler and inspect it. There was not a bit of covering or other protection around the blowoff pipe next to the boiler or in the combustion chamber. The boiler was blown down every day but just the same one day that blow off pipe went out with an awful bang and carried the toilet right out with it as well as the clean out door and about all the brick work near it. There was a man in the toilet at the time and he is still living as far as I know. But I don't see why, because he was right in the middle of the fireworks. The whole days supply of milk was shot. Subsequently I got fired for telling the boiler inspector the true conditions there.

"Wire-Nuts"—An Alternate for Solder and Tape

ELECTRICAL MANUFACTURERS, Contractors and Plant Electricians, who are affected by Order M-43 issued by the War Production Board, January 9, 1943, which reduces the amount of tin and solder and limits the use of solder to 50 per cent of the amount used during the base period, have an immediate solution to their problem in Ideal Screw-On Type "Wire-Nuts."

No rubber, tin or lead are used in Ideal Screw-On "Wire-Nuts" as in solder and tape joints, thus their availability is not affected by this order.

Solderless-Tapeless Screw-On Wire Connectors are not new; they have been on the market for years. Millions are in use! They consist of a cone-shaped spiral spring insert, imbedded in a molded insulation. The joint is made by stripping the wires about ½ in. and then screwing the "Wire-Nut" on the stripped ends—just like screwing a nut on a bolt.

The spring insert presses clean threads into the wires, making a perfect joint electrically and strong mechanically. "Wire-Nuts" are practically indestructible. The insulation will not melt and it's puncture-proof at 10,000 v. The molded shell eliminates any possibility of sharp wire ends protruding and piercing through as is common with solder and tape joints.

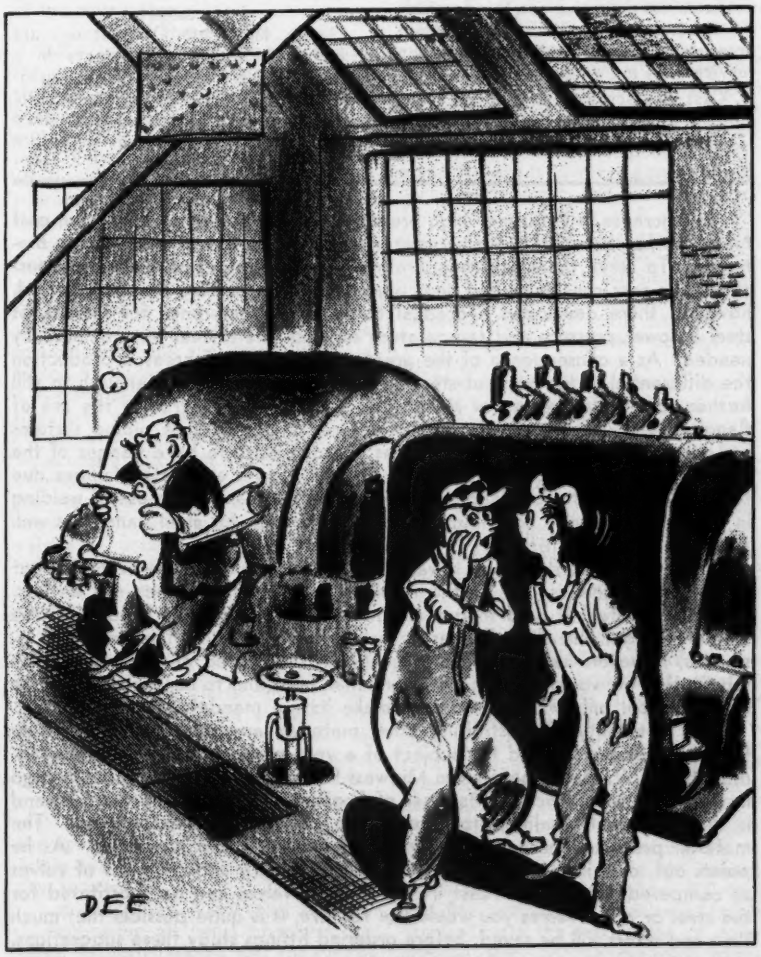
"Wire-Nuts" are full approved; listed by Underwriters' Laboratories, Inc., Factory Mutual Laboratories and other leading electrical authorities. Five sizes are available for making all combinations of wires from 2 No. 18 to 3 No. 10—solid or stranded.

Solderless-Tapeless Screw-On Type of Wire Connectors are manufactured by Ideal Commutator Dresser Co., Sycamore, Illinois, General Electric Co., Meriden, Conn., Weiss & Biheller Mdse. Corp., New York, N. Y., Wiremold Company, Hartford, Conn., and sold through all leading electrical jobbers.

Asphalt Stops Tank Leaks

By E. EMMETT

WE RAN INTO trouble with a zeolite water softener tank that developed several leaks due to the action of the brine used to renew the softening qualities of the zeolite. We could not get a new tank so we cleaned out the interior of the old one and gave it a heavy coat of asphalt, also filled the bottom where the leaks developed with pure asphalt and then put the tank back into operation.



You came to the right place to find a High Pressure Drip, young man, THERE HE IS.

Breaking Bottlenecks in Piping Materials

By G. W. HAUCK
Manager, Engineering Sales, Crane Co., Chicago, Ill.

THE WIDESPREAD use of steel flanges not only in cases where steel is needed but also where cast iron would do has created a "bottleneck" which has been causing many headaches. The only apparent solution for this is to suspend the general use of using steel for all services and to revert to our former habits of using steel only in those instances where conditions make its use mandatory. For all other services, cast iron flanges, which are usually available, make an acceptable substitute. A consistent effort by all users to spread the available supply of steel flanges over a wider area of essential needs and using the alternate cast iron flanges in every possible service, will contribute materially to the war effort.

Cast iron screwed flanges and cast iron lap joint (Van Stone) flanges are available for operating conditions which do not exceed 250 psi saturated steam pressure and in most cases where the service does not exeed 450 deg. F.

Cast iron screwed flanges are available in a wide range of sizes, in the 125- and 250-lb. pressure classes. The screwed flanged joint, properly made, has proved its general utility and satisfactory performance within its pressure and temperature limitations. If prefabricated piping is purchased, an added advantage can be gained by specifying the refacing of screwed flanged joints. In this process, the flange is made up tight until the end of the pipe projects slightly beyond the face of the flange. A light refacing cut is then taken across the face of the flange and the end of the pipe. This provides an excellent gasket-bearing surface to the inside of the pipe because the end of the pipe is flush with the face of the flange. Refacing also produces perfect alignment of the flange face at 90 deg. with the center line of the pipe, and makes for easy bolting without stresses.

Lap Joints

Again, lap joints (Van Stone) are available with cast iron flanges in a range of sizes from 2 to 24-in., inclusive, in both the 125-lb. and the 250-lb. pressure classes. These can be obtained to best advantage when the quantities of various sizes are sufficient to justify production.

Care must be exercised in bolting up any lap joints equipped with a cast iron flange in order to prevent breakage. Pipe fitters are accustomed to finding all lap joints with steel flanges, and they can not apply extremely heavy bolt loads or sledge bolts when cast iron flanges are employed.

Several additional cautions are suggested:

(1) Cast iron flanges should never be used on the ends of any type of expansion pipe bend. Such flanges, as well as those on the piping adjacent to the expansion pipe bends, should always be of steel to preclude breakage.

(2) Cast iron flanges are not recommended for lines handling hazardous fluids, or where fire hazard legislates against their use.

(3) Do not exceed code limitations concerning pressure and temperature in using cast iron flanges.

Other Materials Are Affected

A consideration of "bottlenecks" in piping materials and suggestions for alternates or substitutions cannot be confined to flanges alone. Many other items comprising piping systems are affected by the present shortages and limitation orders. The list of alternates or substitutions contained in the following paragraphs is not intended to be all-inclusive, but to simply focus attention on the necessity for a realistic attitude in thinking about the standards of installations and materials for the various components of any piping system To adhere strictly to hard and fast specifications and to ignore the exigencies of the day is to invite costly delays and often an unnecessary expense in expediting articles not in stock or difficult to obtain while satisfactory substitutes rest in the stock bin, or at worst could be produced in shorter time.

The same considerations discussed above with regard to flanges apply to the use of pinions. As in the case of flanges there has developed a marked preference for steel unions even in cases where cast iron unions would serve. Steel unions are hard to get; therefore specify steel unions only where conditions require them. Cast iron unions are relatively easy to get.

Small Fittings and Valves

Again, in the case of small fittings, shortages of steel fittings can be bypassed by reverting to former practices of using cast iron and malleable iron screwed fittings. These are made in several pressure classes and provide satisfactory service. These also, at present, are more readily available than steel fittings.

Small sizes of forged steel fittings are made today with screwed ends or socket-welding ends. For certain services, users found it desirable formerly to seal-weld the joint made by screwing pipe into a threaded steel fitting. This was partly, if not largely, responsible for the development of the steel fitting with socket-welding ends, which has advantages over the screwed fit-

The increase in the use of high pressures and temperatures during the past ten years has brought about a great increase in the use of steel piping materials. To serve these severe operating conditions steel of necessity superceded the cast irons which had been used previously. During this same period, however, there developed a gradual but definite preference for the use of steel in lower pressure and temperature services where steel was not actually needed. As a consequence of the greater demand and increased production the differential in the costs of steel and cast iron became low enough to still further accelerate the use of steel. This was particularly true of the use of flanges. The use of steel flanges, therefore, on the bulk of piping systems has become accepted practice. It was an advantage to have flanges of the same material as the pipe and the use of steel flanges eliminated failures due to breakage of cast iron flanges in transit. The increase in the use of welding in piping systems also contributed to the preference for steel flanges as well as valves and other fittings.

In normal times this trend toward the greater use of steel was logical but today, when steel is one of the most critical materials it has got us into difficulties. Steel is hard to get and many jobs are held up because of the inability to get the steel flanges or valves specified. In many of these instances, however, cast iron fittings could be substituted and in making this substitution we would be doing no more than reverting to our former practice of using steel only where conditions make its use mandatory.

This possibility of substituting other materials and other types of fitting for those needed formed the subject of a very practical and interesting address by G. W. Hauck before the Midwest Power Conference held in Chicago last month. Mr. Hauck, is Manager of Engineering Sales for Crane Co. and is therefore, well qualified to give advice on this important subject. The material presented here, is a fairly complete abstract of his paper. As he points out, cast iron is relatively easy to get, so are certain types of valves as compared to others; if cast iron and these valves can be substituted for the steel or other valves you would like to have, it is quite possible that much time and effort will be saved. Before ordering fittings study these suggestions.

tings when the joint between the fitting and the pipe is to be welded. Thus, we normally find two types of small steel fittings—screwed end for the threaded joints, and socket-welding end for the welded joints.

But when shortages of steel preclude maintenance of consistent stocks in both types, a construction program might be accelerated by the acceptance of either type or a combination of both types in the assorted sizes and variety of fittings needed in a job. Even though the socket-welding fitting is better than the screwed fitting with a seal-weld, the latter is merely a reversion to a practice formerly followed satisfactorily. Conversely, a job may normally require screwed steel fittings and, if they are not available when needed, the substitution of socket-welding fittings, if obtainable, is the answer to that dilemma. And, a mixture of both types of fittings in the same line, while not 100 per cent mechanically correct or perhaps in tune with a standard in a plant, might solve a vexing and costly delay in construction.

The suggestions in the preceding paragraph apply with equal force to small steel valves which are made with socket-welding or with screwed ends. A willingness to use either type of end connection, or an assortment of both, may pay dividends in time saved. In some cases it may be the practice to use small steel valves with flanged ends. If, some day you find that flanged valves, or the flanges, or the studs, or the desired gaskets (it takes all of these to make this flanged installation) are not available when needed, check to learn if a socket-welding end or a screwed end valve can be used.

Maybe you can use an angle valve in place of a globe valve

Don't Overlook Angle Valves

Globe valves are used to a much greater extent than angle valves. The demand for valves today means that the stock bins for globe valves may be empty while the bins for the corresponding angle valves may contain the answer to that immediate need. Globe valves are used in straight lines of pipe, but almost all piping contains "turns." Often a "turn" is not far from the place where the globe valve is to be installed. An angle valve could be used here to take the place of the globe valve and the "turn," and eliminate one joint.

By-Passes on Valves

A by-pass is a "must" for many valves. While valves with by-passes are listed in a wide variety of sizes and pressure classes, the predominant demand and the resultant production is for regular valves without by-passes. To attach the by-pass, which involves extra labor operations, may delay procurement of a valve with a factory-built by-pass. While suffering from this delay, a regular valve often may be obtained in much less time. Possibly the installation is such that the by-pass can be constructed independently of the valve and around it by providing connections in the adjacent pipe or fittings and constructing the by-passes on the job.

Caution: When constructing by-passes around valves, be sure to provide flexibility in the by-pass piping to compensate for expansion stresses.

If the materials for constructing the by-passes are not at hand, it might be practical to install the valve and "limp along" until such time as the by-pass materials are secured and installed.

A few classes of gate valves are regularly listed in both the wedge disc and the double disc types. Users have developed preferences for each over the other, but in many instances one type can be substituted for the other without detracting from the effectiveness of the installation.

Valve Stem Packings

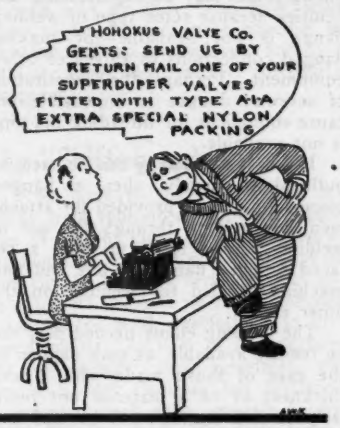
All valves are regularly equipped in the factory with valve stem packings that are suitable for general service in keeping with the pressure, temperature, and operating conditions for which various valves are rated. When every effort is being devoted toward the manufacture of valves in the greatest volume which is possible to meet abnormal demands, it is apparent that an order for valves to be equipped with a packing other than that regularly provided would mean a break in production. Costly delays ensue for both the manufacturer and the user. It is far better to discard any predilection for a specific packing when such a choice interferes with normal procedures and the possible slight advantage can only be gained at the price of delay in procurement. Even when a special packing must be used for unusual service conditions, it is suggested that regular valves be obtained and the procurement and installation of the desired packing accomplished by the user subsequently.

Special Valve Operators

Special valve operating devices, such as floor stands, hydraulic cylinders, gears, air motors, electric motors, etc. normally are ideal from a mechanical or operating standpoint for specific installations. Under current conditions, however, specifying a regular hand operated valve will speed up deliveries and the completion of projects. Use the special operators only when absolutely essential and when no substitution is practical.

Screwed, Flanged, or Welded Joint

Embracing all items of valves, fittings, fabricated piping, etc., the type of end connection or joint must be kept in the foreground of the thinking of those who are alert to break construction bottlenecks. For instance, if shortages involve flanged connections, perhaps a screwed or a welded connection is the answer to the problem. Perhaps a flanged valve or fitting is available, but the flanges or the studs are not. Can a welding end valve or fitting be used? It just might mean the saving of valuable time. Such thinking and flexibility in making substitutions may prove helpful many times.


HOHOKUS VALVE Co.
GENTS: SEND US BY RETURN MAIL ONE OF YOUR SUPERDUPER VALVES FITTED WITH TYPE A-1-A EXTRA SPECIAL NYLON PACKING

Don't specify special packing

Fabricated Piping

That flanged elbow with a special dimension on one end, or that flanged tee with an elongated dimension on the run, or that special base elbow can be difficult if not impossible of procurement because it involves pattern work, special machining and handling, etc. Inquiry may disclose that this problem can be solved by the shop fabrication of a piping assembly. Special tees can be made by welding the outlets in pipe and providing flanged ends, threaded ends, or ends beveled for welding. Bases can be applied by welding.

Pipe bends can be used for turns, offsets, and for accomplishing all sorts of changes in direction. The variety of shapes into which pipe can be bent suggests interesting possibilities. The same holds true for welded headers with multiple nozzle openings, drip pockets, tapped bosses, etc., or for welded assemblies. Reductions in sizes can be accomplished by swedging, and end closures can be fabricated by welding. And so it goes.

Bolting Materials

Having previously described the trend toward an increased use of steel in other products, it is well to direct attention to a concurrent trend toward the application of alloy bolting materials in flanged joints when the actual operating conditions did not necessarily require this class of product.

Commercial steel bolts or studs are recommended for temperatures up to 500 deg. F. Alloy studs are needed when temperatures are above 500 deg. F. The prevalent scarcities of alloy steels dictate the installation of commercial steel bolting material whenever it can be used.

If You Weld

The plant which has adopted welding as the exclusive tool for making piping joints may be experiencing difficulties because some type of welding flange is not available for making flanged connections to valves or other equipment. Perhaps the substitution of screwed flanges is impossible because equipment for threading the pipe is not available.

If a cast iron flange can be used, as outlined previously, then a flanged connection can be provided for attachment by welding through the use of welding nipples made up with a refaced screwed flange on one end and machine beveled for welding on the other end.

The welding elbow needed may not be readily available, as may happen in the case of those made with a wall thickness or of a material not regularly carried in stock. A beveled end pipe bend made from pipe of the desired thickness or material sometimes can be fabricated and save time. The pipe bend would have longer center to end dimensions, but many times that presents no particular problem.

Piping Ingenuity Pays Dividends in Time-Saving

A few simple substitutions are listed herein to illustrate how a little ingenuity can solve many every-day problems of shortages.

A reducing screwed flange often can be made by tapping a blind flange, either concentric or eccentric as desired. This is practical, provided the tapped opening is not too large in pipe size to preclude a sufficient length of thread for a satisfactory pipe joint.

A piece of plate, if available, can be fashioned into a slip-on welding flange or a lap joint flange if the thickness is increased, particularly in the latter, to compensate for the lack of hub. Similarly, a blind flange can be fabricated from steel plate. These are not recommended necessarily as good practice, but they are satisfactory in certain instances, especially in emergencies.

Instead of a 4 by 3-in. screwed elbow required for an extension of a pipe line during a shut-down, perhaps a 4 by 3-in. screwed tee with a 3-in. plug would answer the purpose. If this happened to be a flanged job and the reducing fitting were not in stock, would a straight fitting and a reducing flange suffice? If it were a welded job and the reducing fitting unavailable, would a straight fitting and a reducer satisfy the need? Generally, the answer will be in the affirmative.

FOR THE PLANT ELECTRICIAN

Overloading Electric Apparatus as a War Measure

PERMISSIBLE overloading of electric apparatus as a means of conserving the vital resources of the electrical industry in wartime was discussed by Robert Treat of General Electric's Central Station Engineering Department in a paper presented recently at a meeting of the System Operators of New England.

According to Mr. Treat, the real problem lies in determining the advisable limits for overloading. The emergency loading procedure must be followed cautiously if gains are to exceed losses. He pointed out that exact knowledge concerning the life of electrical insulation assemblies is limited because of the complexity of the problem.

"In any piece of electric equipment there are an almost infinite number of possible paths of electrical breakdown over the insulation assemblies incorporated in the device, and the continued availability of that device requires a sufficient resistance to every one of these paths at all times to prevent electrical failure. Conversely, only one path has to fail to put the whole equipment out of service," he said.

Mr. Treat explained that the testing of varnished cambric tape to potential breakdown after it has been subjected to time-temperature cycles early indicated no clear gradual decay of insulating properites.

"In fact," he said, "the electrical breakdown would often increase with time and temperature until the physical deterioration of the tape indicated a sudden electrical failure."

"The idea of testing the varnished cambric tape samples for physical deterioration developed and the vast majority of these tests actually have been readings of the ultimate tensile strength of such tape against varying time at constant temperature and varying temperature at constant time."

"The desirable range in such time periods plainly extends at least to the life of the equipment. In reality it would be very helpful to be able to run such data out to 50 yr. for instance, to be sure of general trends. Such ambitions, however, are not attainable in practical testing and therefore short time data have had to be speculatively extrapolated for the longer times."

Mr. Treat went on to point out that, in addition to the thermal effect of high temperature on apparatus insulation, there is a mechanical effect due to variations in temperature, encountered primarily in large rotating apparatus.

As a machine heats up, the iron in the core and the copper in the coils expand, but not to the same extent. Unless the coils are so loose in the slots that they rattle around, which is seldom the case, this differential expansion causes chafing of the insulation, which must slip on the copper, on the iron, or within itself. Repeated cycles of heating and cooling due to changing loads and ambient temperatures may ultimately tend to destroy the insulation by this purely mechanical action.

When it becomes necessary to overload a piece of equipment, Mr. Treat recommended the following steps:

1. Examine your own experience with that equipment or with others like it, for any clues as to its ability to carry overload. A number of groups are working on this problem and if your own experience is inconclusive, possibly some of your fellow operating companies do have such experience.

2. Look into the possibilities of improving heat dissipation if that is found necessary. Heat dissipation can sometimes be improved in rotating machines by adding blowers or fans, or possibly changing the existing fans so as to improve the ventilation. Increasing the hydrogen pressure in hydrogen-cooled generators from ½ to 15 lb. permits an increased loading of 15 per cent. The effectiveness of heat dissipation from transformers can generally be increased very substantially by blowing air on them, by spraying with water, or by providing them with forced oil circulation through external coolers. The external coolers may be either water cooled, air cooled or a combination of both.

3. If you need this help, the manufacturer of the equipment may be able to make useful comments based on his knowledge of its design. He may know of certain characteristics, margins or limitations not evident from the nameplate rating. When you do call on the manufacturer for such assistance, it will help him to help you if you give him as complete information as you can. This will include not only the complete identification of the equipment, but comments as to its operating history, and particularly, if you have them, indications of temperatures that have been reached, and the exact loading at which these temperatures were attained; in other words, a load heat run. This is of value because sometimes—and this applies to larger apparatus—the manufacturer is unable to make heat runs at full load and his present knowledge of the heating characteristics of the device may be based on synthetic tests or possibly only on calculations. In such cases data from the actual field runs are very helpful to him in giving you an intelligent opinion as to the probable effects of the overloading.

4. When apparatus is operated at considerable overload, it should be carefully watched. An eagle eye should be kept on temperature, and the apparatus should be kept as clean as possible. Dirt almost always interferes with proper heat dissipation.

Need An Air Raid Whistle? Make One

A METHOD by which any community or company, requiring air raid warning equipment can easily obtain such devices, and at the same time help relieve jammed up air raid equipment production facilities, is offered by a device of Hervey N. Beishline of Benton, Pa.

The air raid whistle (Fig. 1), devised by Beishline, was built entirely from pipe and pipe fittings and was arc welded throughout with equipment supplied by The Lincoln Electric Co.

As shown in the sketch, the bell is constructed of 4-in. diameter pipe, 14 in. in length, welded to a ½-in. disc at top and with a chamfer on inside of bottom. The outside frame, supporting the bell, is all of flat iron, measuring ⅜ in. by 1¼ in. by 24 in. A ¾ in. pipe sleeve, cut in half, 3 in. in length, serves as the bell adjustment. The pipe connecting the whistle and the steam supply is 1¼ in. in diameter.

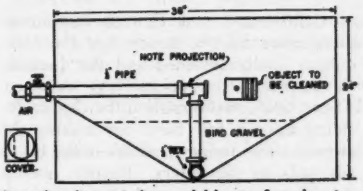
Beishline, who is employed as a steam plant foreman at the Magee Carpet Co., Bloomsburg, Pa., was credited by Chief of Police B. F. Jacoby as having constructed the most effective air raid whistle that had thus far been tested.

The "zoom, zoom" bellow of the whistle is accomplished by raising and lowering the weights. When the weight is lowered, the pitch becomes higher, and as it is raised the pitch is lowered. Steam goes through the whistle at all times.

Referring to the sketch, the method of operating the warning is to pull whistle valve No. 1 wide open, then wire No. 2, which is connected to the bell lever, is pulled allowing about 10 sec. for complete travel, then releasing during an interval of approximately 10 sec. This operation can be repeated as often as desired. The weight must be sufficient to return the bell lever and wire to normal position.

Home Made Sand Blaster

SAND BLASTING is an effective way of cleaning castings and small parts easily, quickly and cheaply. The attached sketch shows a sand blaster made up of small pipe and designed by A. R. Shull, a jobber for the American Hammered Piston Ring Division of the Koppers Co., Bird gravel, which can be obtained in almost any grocery store, or sand, piled in the vee bottom is picked up by the vacuum created by the air jet.



Details of a simple sand blaster for cleaning small parts

As shown in the sketch the air pipe should project well into the tee. The small insert in the corner shows the opening for inserting the piece to be sand blasted. This is made by using two pieces of innertube overlapping like a curtain.

While gravel or sand is ordinarily used in devices of this kind, nail clippings, a by-product of the nail manufacturing process when the point is put on, are said by those who have tried them to be cheaper, more effective in cleaning and can be used over and over until the small metal particles completely disappear.

The "Shiftograph"

From time to time we receive requests from subscribers for work schedules of various kinds so that the working hours and days of various groups of men can be properly arranged. In answer to such requests we have published a number of work charts used in different plants. To help in the working out of suitable work schedules, the George S. May Company has developed a perpetual work shift schedule known as the "Shiftograph". This is an instrument of the circular slide rule type.

This chart will be sent free by the George S. May Co., 2600 North Shore Ave., Chicago, Ill., to executives requesting them on their company letterheads. One hundred per cent activity day in and day out is hardly practical, but the May Co. by means of this chart offers you plans that can be used to achieve rather high percentages. The description of the plans and the instructions for operating are printed on the back of the chart. The chart should be an aid to companies now operating upon a 24-hr. basis.

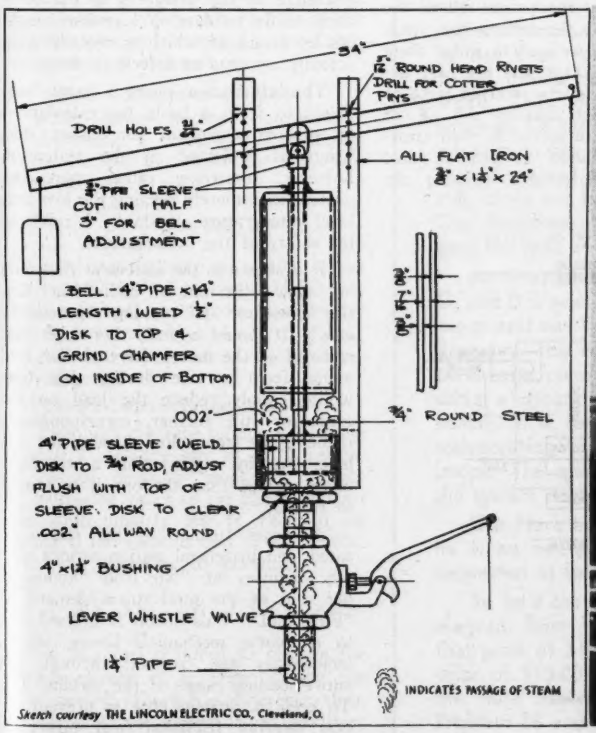

34"
½" ROUND HEAD RIVETS
DRILL FOR COTTER PINS
DRILL HOLES
ALL FLAT IRON ⅜" × 1¼" × 24"
¾" PIPE SLEEVE CUT IN HALF 3" FOR BELL-ADJUSTMENT
BELL - 4" PIPE × 14" LENGTH. WELD ½" DISK TO TOP & GRIND CHAMFER ON INSIDE OF BOTTOM
.002"
¾" ROUND STEEL
4" PIPE SLEEVE. WELD DISK TO ¾" ROD, ADJUST FLUSH WITH TOP OF SLEEVE. DISK TO CLEAR .002" ALL WAY ROUND
4" × 1¼" BUSHING
LEVER WHISTLE VALVE
1¼" PIPE
INDICATES PASSAGE OF STEAM
Sketch courtesy THE LINCOLN ELECTRIC CO., Cleveland, O.

Fig. 1. Low Cost Air Raid Whistle Welded from Reclaimed Pipe

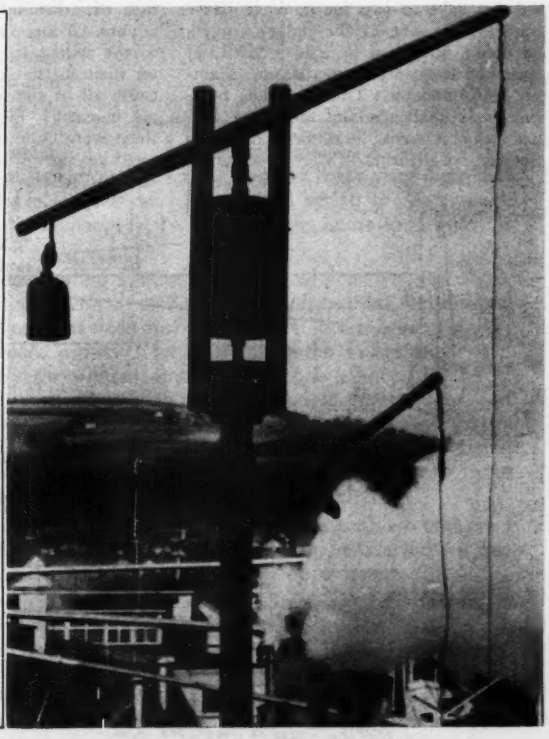
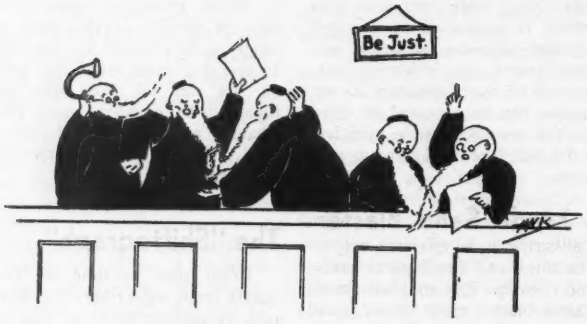


Fig. 2. Photograph of the home-made Air Raid Whistle



How Would You Do It?

PROBLEM 27. STEAM VS. ELECTRICALLY DRIVEN AUXILIARIES

WHATEVER might be said in regard to Problem 27 on the question of steam versus electrically driven auxiliaries, one thing is quite definite, the discussion on it by the Board of Judges added nothing to an understanding of the subject. As a matter of fact, Our Hero might as well have sent the solutions to the War Manpower Commission in Washington insofar as his chances of getting a clear ruling are concerned.

From the beginning, the judges seemed to think the whole problem rather silly. What was this guy, Graves, worrying about; he didn't have to pay the cost of operating the station, did he? Suppose he did burn a couple of thousand tons of coal more, as long as he did not have to pay for it, what of it? Furthermore, one of the judges argued, he didn't need any heat in Florida, at least not according to the Miami Chamber of Commerce. This assertion, however, was challenged by the Chief Justice, who, it seems, is addicted to Palm Springs, California. The free-for-all that followed as to the relative merits of California versus Florida was something more than a debate, but the commotion finally subsided and the question of awarding the prizes was resumed. There was considerable difficulty in deciding upon a fair basis for making the awards. The judges couldn't make heads nor tails to the letters. Finally, one of the members suggested throwing the letters up in the air and awarding prizes to those that stuck to the ceiling. Apparently, this suggestion met with unanimous approval because they were so engaged when, at the request of the neighbors, the police broke down the door of their chambers and dragged them back to their upholstered cel—quarters.

The judges effectively disposed of, the task of awarding the prizes fell to the editors. None of the letters had stuck to the ceiling so we had to judge them on their merits. This was not easy because all of the letters received were of an unusually high quality and all of them were quite in accord in their treatment of the problem. In general, most of the letters advocated running the electrically driven auxiliaries and operating the turbine with full extraction as long as operating conditions permitted.

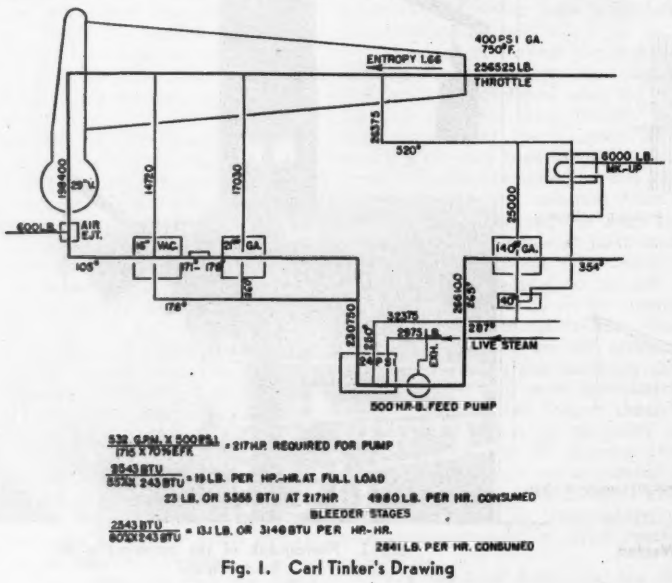


Fig. 1. Carl Tinker's Drawing

Although, as pointed out in the March issue, Problem 27 was not new, it was an extremely involved one, demanding a wide practical knowledge of modern power plant operation, and it was interesting to note that nearly all of the contestants were men having these qualifications.

Merrill A. Young of Steilacoom, Washington, and Carl C. Tinker of Lapeer, Michigan, received the $25.00 War Bonds for submitting the two best letters and Rollin A. Lager of Milwaukee, Wis., was awarded the $10.00 prize for the next best letter. Both Mr. Young and Mr. Tinker stressed the use of the motor driven boiler feed pump whenever possible from a purely heat balance standpoint but Mr. Merrill's comment on the safety aspect is well worth keeping in mind.

Here are the prize winning letters.

$25.00 WAR BOND
Merrill A. Young
Steilacoom, Washington

THIS PROBLEM, as is indicated, is not new; and the difference of opinion among the several members of the operating staff appears only a healthy, friendly difference. The fact is that operating changes cannot gain much for either side. You simply cannot profit trading "tit" for "tat" when the two have substantially equal value.

The condition described by Mr. Graves exists in many central stations and indeed seems to present a sort of challenge by the designers to the operating staffs to develop ingenious methods by means of which to remedy what actually amounts to defects in design.

The information given is hardly sufficient to form a basis for calculations to support argument for either side. There is indicated in the statement, however, something rather more important than merely keeping the low heat level temperature constant. I refer to the safety of the main turbine.

It is shown in the statement that during some 6 hr. out of each 24-hr. day, the generator is running "practically idle." It would appear, therefore, that removal of the motor driven boiler feed pump from service during this time would simply reduce the load on the generator still further, correspondingly reducing the steam flow through the turbine, thereby aggravating a condition more serious than the one it is sought to remedy.

A steam turbine of the size indicated, and in central station service usually requires at "No load" about 10 per cent of the total steam demand at "Full load." This steam is utilized (1) to overcome mechanical losses, which, incidentally are constant through the entire loading range of the turbine. (2) To keep the turbine cool, to prevent excess internal frictional heat injury to blading. (3) To prevent undue condensation in several of the last stages thus

guarding against condensate cutting of cylinders and diaphragms in certain types of machines, which cutting, once started, results in progressively increasing interstage leakage and decreased efficiency of the turbine. (4) To supply heat to the boiler feedwater through the several extraction outlets and sometimes to furnish evaporator steam from one of the early stages.

Since station service load is nearly always about 10 per cent of the total plant capacity in plants of the size indicated, it is reasonably certain that here the load does not drop below this minimum. Therefore, if the water-rate of the turbine is, say 11 lb. per kw.-hr., the full load steam demand would be: $11 \times 25{,}000 = 275{,}000$ lb. per hr.—and the "floating demand would be 27,500 lb. per hr. If this approximates the picture and 500 hp. of load is dropped.

$$\frac{500}{1.34} = 373 \text{ kw. and } 373 \times 11 = 4103 \text{ lb.}$$

per hr. When this is subtracted from 27,500 we have left 23,397 lb. per hr., not enough to provide certain safety for the turbine.

It is true that steam starved from the turbine by shutting down the motor-driven feed pump can be at least partly compensated for by throttling the extraction line to the 7th stage heater, as Mr. Graves suggests. But this is not at all good practice and I think pressure in the 7th stage would be very low anyway under these light load conditions.

It may be that, under certain circumstances the throttling of extraction outlets can be justified, but, in general, the practice is frowned upon, and for obvious reasons is resorted to as strictly an emergency measure.

Fuel Consumption Comparison

MOTOR-DRIVEN BOILER FEED PUMP

Assuming a fairly straight power curve for 500 hp. motor for the whole 6-hr. period:

$$\frac{500 \times 0.8}{1.34} = 298.5 \text{ kw.}$$

Then, if the fuel rate is, say 0.7 lb. per kw-hr. $0.7 \times 298.5 \times 6 = 1253.7$ lb. of fuel required to operate the motor-driven pump six hrs.

But let us see about the turbine-driven pump.

TURBINE-DRIVEN BOILER FEED PUMP

This high pressure turbine exhausting against a back pressure of 40 lb. per sq. in. would probably work to capacity in delivering water to the boilers against the approximately 900 ft. head, if its rating is the same as that of the motor; then still in terms of kilowatts:

$$\frac{500}{1.34} = 373 \text{ kw. and } 373 \times 0.7 \times 6 =$$

1566.6 lb.—fuel required to operate the turbine driven B. F. pump during the 6-hr. period. There is a difference, then, in favor of the motor driven auxiliary of 312.9 lb. of fuel.

Assuming a Btu value for the fuel of 18,000 per lb.

$$\frac{18{,}000 \times 312.9}{0.7} = 8{,}046{,}000 \text{ Btu} = \text{the}$$

heat value of live steam which can be drawn from the 400 lb. saturated steam supply, while the motor driven pump is running before the fuel expense of operating the turbine driven pump is reached. This difference is equivalent to:

$$\frac{8{,}046{,}000}{1204.1} = 6682 \text{ lb. 444 deg. steam.}$$

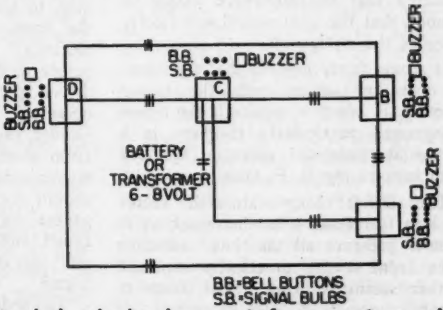
Heat equal to the difference between extraction from the 7th stage and the total value of boiler feed pump turbine exhaust is added to the boiler feedwater when the steam driven pump is in service. But a considerable portion of the heat ordinarily used to generate energy to operate the 500-hp. B. F. pump motor would be lost in throttling the 7th stage bleeder as Mr. Graves proposes, making necessary even greater heat reinforcing in the low level system because the 7th stage heater is in that area.

Most turbines in central stations are designed to deliver their ratings, and at the same time to maintain through stage heat extraction, and the necessary auxiliaries an even system heat balance. But the "light load" and "no load" conditions are difficult to meet in design. In the constant struggle for betterment of full load efficiency it is quite understandable why light load problems are not regarded seriously by designers. Sometimes these "bugs" make the operating engineer feel that the designer must have stopped before the problem and said to himself, "Oh, well, the operators have to have something to worry about" and let it go at that.

A familiar rule in power plant operating procedure is to do nothing manually that can be done automatically. This is a good rule because the human element in manual control cannot be gauged by the same standards as other factors which are mechanical in operation. That is why hand control on any part of the system should be avoided if possible; it is almost impossible to get two or more plant crews to operate under a different set-up in the same plant with-

Problem 28
OUR HERO RUNS INTO A WIRING PROBLEM

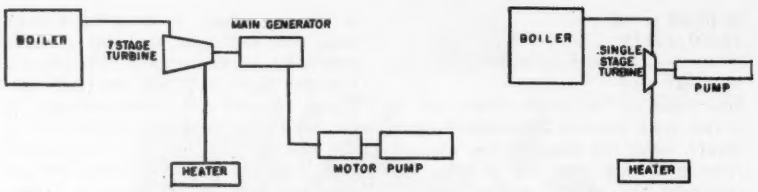
OUR HERO has sort of kept in the background the last couple of months. The problems he has run into have been rather complex and he has been content to let others do the work. This month, however, he has been working on one which at first seemed quite simple but he has been at it for some time and still does not have the answer. It is a little wiring problem which Carl Bachman of Schenectady, N. Y., gave him some time ago. It goes like this:



An intercommunicating system, consisting of four stations, A, B, C, and D is equipped with three 2-wire bell push buttons, three signal lamps and one buzzer at each station, as shown in the accompanying diagram. The *cable* provided for connecting the four stations is a *three wire conductor* without any armor. There is no possibility of using a ground since the wiring is concealed in wood, floor and ceiling. It is, furthermore, impossible to add any wires without heavy redecorating expense. The tenant insists on the use of the signal lamps. The question is, how would you connect the wires to make the system work.

Our Hero has spent considerable time on this problem and since he is no nearer a solution than he was when he started he has requested us to put it up for solution in this department.

So let's see what you can do with it. Send us your solutions in diagram form accompanied by a short explanation, by May 31. A first prize of $15.00 will be awarded for the best solution; a second prize of $10.00 for the second best and a third prize of $5.00 for the third best solution. Entries in this contest should be marked Problem 28 and should be addressed, Contest Editor, Technical Publishing Co., 53 W. Jackson Blvd., Chicago, Ill.



TURBO-ELECTRIC DRIVE STEAM TURBINE DRIVE

Fig. 2. Rollin A. Lager

out causing a condition of unbalanced nervousness both in men and equipment.

When conditions such as those under discussion arise, economy becomes for the moment a secondary matter and the safety of equipment of primary concern. So that the more or less questionable saving effected by operating the turbine driven B. F. pump would, I think, be more than offset by maintaining the usual operating set-up, reinforcing the low heat level system necessary by injecting, automatically, if possible, live steam into the B. F. tank to control temperature in the low level area.

All conclusions are of course only approximate and are based mostly on hypothesis because many factors are not known about the operation. It cannot safely be asserted that the cost of maintaining low level heat balance would be exactly the same in both cases, but it can be stated that the difference would be so small that the gain would not justify changing the equipment.

It seems fairly evident that the regular operating set-up with the motor driven B. F. pump in service is the better arrangement particularly if there is a thermostat controlled valve on the live steam inlet to the B. F. tank.

The 800-ft. long saturated steam line is a bad feature but inasmuch as it is under pressure all the time, radiation losses from it are practically constant whether steam is being drawn from it or not.

There is very little to choose from—so little advantage for either side that I may say the safety factor, and a preference for maintaining the "Status Quo" even in power plant operation, among all the elements of the problem impel me to side with Mr. Graves' associates.

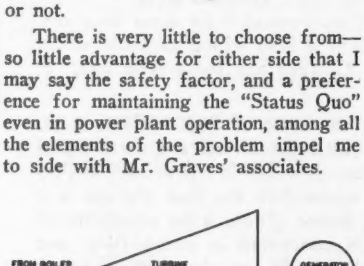


Fig. 3. If the efficiency of the main unit was not higher than that of small auxiliary drive turbines we would see heat cycles like this

$25.00 WAR BOND
Carl C. Tinker
Lapeer, Michigan

As SUGGESTED by the title of Problem 27, "Steam Driven Auxiliaries Vs. Electric Motors," the question concerns principally the comparative efficiency of two methods of boiler feed pump drive, either directly by an auxiliary steam turbine, or by the main turbo-generator through an electric motor, both turbines exhausting into the feedwater heating system. Since the prime purpose in feedwater heating is to recover the heat contained in steam which would otherwise be exhausted to the atmosphere or to a condenser, and since it is desirable to produce the greatest amount of horsepower for a given amount of steam consumed, the problem becomes simply a matter of comparing the heat consumption of the auxiliary turbine per horsepower hour delivered at the pump coupling, to that of the bleeder sections of the main unit while allowing for the electrical losses in transmitting this power to the coupling of the electrically driven pump. As to the questions of operating procedure submitted by Mr. Graves, such as when and how to change from electric to steam auxiliaries while maintaining the greatest efficiency, these should for the greater part become apparent once the most efficient drive is found, and the relative economy of various operating conditions can be determined.

In order to make this comparison, and to get a better idea of conditions in the plant as they might exist under approximate full load, a simplified diagram of the main turbine and regenerative heaters is presented, showing the steam and condensate flow and temperatures for all of the stages. Although some of the smaller units have been omitted from the diagram in the interest of simplicity, the heat transfer from them has been recognized in most instances. Such omissions as have been made are negligible with respect to the limitations imposed by the lack of data concerning load conditions, turbine steam condition, etc. Nevertheless, a fairly accurate appraisal of the situation can be made not only for the load illustrated but for other loads and operating conditions.

It is assumed that the turbine is operating at near full load and the throttle flow of 256,525 lb. is divided between the three extraction stages according to their heat requirements, the balance going to the condenser and returning through the eleventh and seventh stage heaters to the open heater which is presumably of the deaerating type. Here the 3rd stage condensate and the 2.25 per cent make-up is added at 40 lb. saturated temperature.

At this point it is interesting to note that the 2975 lb. of exhaust steam required for this heater is much less than that furnished by the steam turbine driving the feed pump as shown by the calculations for this unit which are given below the diagram. This is in accord with Mr. Graves' statement that there was too much steam available at heavier loads with the steam pump running.

And right at this point also, I should like to dispose of the proposal for using live steam for making up the quantity of steam required for this heater in particular, and for feedwater heating in general. I consider this poor economy in any case and justified only when process steam is required for softeners for instance, or where the exigencies of operating conditions make its use imperative. Furthermore, the long all purpose steam line used in this instance would involve considerable additional loss owing to the necessity for keeping it up to normal temperature during the night when it ordinarily would stand idle under moderate pressure.

To return to the turbine, the feedwater temperature of 354 deg. would indicate that the machine was at or near full load because the most efficient feedwater temperature for this unit is given by Kent as 312 deg. and this would occur at the most efficient load which is 70 per cent to 80 per cent of full load. Therefore it is obvious that the turbine should provide satisfactory feedwater temperatures well into the lighter loads without additional steam being fed to the exhaust heater other than that which might be supplied by the exhaust from the oil pumps and other small auxiliaries. This conclusion is substantiated by the statement in the problem that it is necessary to start the auxiliary steam pump only when the load becomes very light late at night.

As to the comparative efficiency of the electric pump versus the turbine pump, the latter unit probably would have an engine efficiency of about 55 per cent, which with an adiabatic heat drop of 243 B.t.u. per lb. of steam from 400 lb. ga. at 750 deg. to 21 lb. ga. would give it a full load steam consumption (theoretical) of 19 lb. per hp. hr. at the shaft coupling. Since the pump requires but 217 hp. when handling full load feedwater requirements, the auxiliary turbine is operating at less than ½ load and would consume 20 per cent more steam per hp. hr. making the corrected figure 23 lb. per hp. hr. or 5555 B.t.u. per hp. hr. While it is difficult to present an exact comparison of the non-condensing auxiliary with the condensing bleeder type main unit, we may consider the first stages of the main unit as exhausting through the bleeder outlets and giving the same amount of heat to the feedwater for the same amount of steam passed through these stages as would be passed by the auxiliary. As-

suming an engine efficiency of 80 per cent for the bleeder stages of the main unit, the B.t.u. consumed per hp. hr. under the same steam conditions is 3140 and the theoretical steam consumption is 13.1 lb. Therefore, for the same amount of steam this unit develops 75 per cent more hp. which would supply the relatively small losses through the generator and to the motor pump coupling with a considerable quantity to spare for other useful load. It is obvious therefore that the 500 hp. turbine is attempting to compete with the bleeder stages of the 25,000 kw. unit as a power producer, both operating under the same steam conditions.

As an over-all picture of the effect of cutting in the steam driven auxiliary while the main unit is under load, as seen from the diagram, it would be necessary to follow Mr. Graves' suggestion and throttle one or more of the stages thus lowering the temperature of the water leaving those heaters and allowing the exhaust heater to absorb more heat from the auxiliary. Another way of doing this might be to allow the pressure in the exhaust heater to build up to the 40 lb. pressure of the drip tank thereby raising the temperature of the water leaving the heater to 278 deg. and allowing it to absorb 5500 lb. more exhaust steam. This would reduce the amount of steam extracted from the 3rd stage and therefore the efficiency of this blade group would probably raise the feedwater temperature further, and would increase the steam rate of the auxiliary enough perhaps to offset to some extent any advantage gained. Any such schemes as have been suggested, while not greatly affecting the efficiency of the unit and therefore allowable for short periods, brings the outfit closer to straight condensing operation and tends to defeat the purpose of the bleeder design. The reduction in heat consumption of a unit of this size owing to extraction operation is 8.9 per cent below that of non-extraction operation. Since the steam furnished by the auxiliary turbine is 4980 lb. per hour or 8.6 per cent of the total steam extracted, about this same portion of the gain owing to extraction would be lost by using the auxiliary turbine.

In the operation of any plant the fellow on the job who has all the responsibilities and headaches connected therewith, is most likely better qualified to decide what plan of operation to follow than is someone seated comfortably in front of a typewriter many miles away. However, I think that I should run this turbine with full extraction as long as operating conditions permitted, being guided by the allowable limits of variation in final feedwater temperatures and the pressure in the exhaust heater. Then when the necessity for more steam in the heater was foreseen, the steam pump could be started and the load gradually shifted to it as fast as the heater could absorb the extra steam, provided of course that throttling type valves are available in the pump discharge lines and that the feedwater and pump controls would operate satisfactorily. This would allow the auxiliary turbine to develop whatever power it could while taking over the load and would be much preferable to using live steam during this transition or during the hours of light load. This plan should require no more attention than that of throttling the bleeders and the process could be reversed when it became possible to go back to the electric drive.

$10.00 CASH PRIZE
Rollin A. Lager
Milwaukee, Wis.

UNDOUBTEDLY Mr. Graves' power plant was designed for highest efficiency on a set of conditions which were assumed to be the normal operating conditions. It seems, also, to have been designed to take care of light load conditions with some sacrifice in efficiency, which is natural. The following discussion is in defense of Mr. Graves' method of operation described as follows:

(1) Normal operation should be with the motor driven pump as much as possible without using an outside source of steam for heating the feedwater.
(2) Light load operation should be with the turbine driven boiler feed pump.
(3) When the load is near the breaking point between the two systems, too much exhaust steam to supply the demand of the boiler feed tank temperature and pressure and too little without it, throttle the seventh stage extraction bleeder.

Operation in this manner should give the highest possible efficiency for the plant in question.

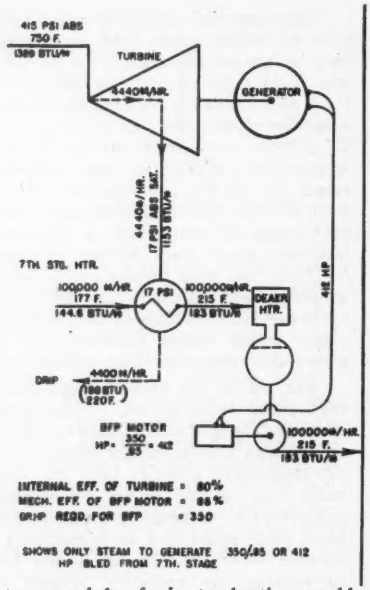
The presence of extraction feedwater heaters in the plant immediately presupposes that electric driven auxiliaries should be used unless the plant is used as a heating station, which apparently it is not. The reason for this is that the main turbine is far more efficient between the steam inlet and the bleed points for feedwater heating than a single stage auxiliary drive turbine usually is. In the last paragraph of his problem Mr. Graves states that the most economical use of the low pressure turbine wasting 70 to 75 per cent of the heat to the circulating water cannot equal the practical use of the exhaust steam where every B.t.u. is utilized. This is true but in a cycle in which steam can be taken from a more efficient turbine in quantities great enough for the heating requirements the use of the more efficient unit will lower the overall steam rate of the cycle by producing a greater amount of power per pound of steam used for feedwater heating. In his plant the seventh stage bleed point corresponds to the exhaust from the boiler feed pump turbine. Steam extracted at this point has done more work per pound than steam from the exhaust of the single stage auxiliary turbine. The total heat of the extracted steam will, of course, be less but the more efficient use of the steam will be reflected in the cycle steam rate making it lower.

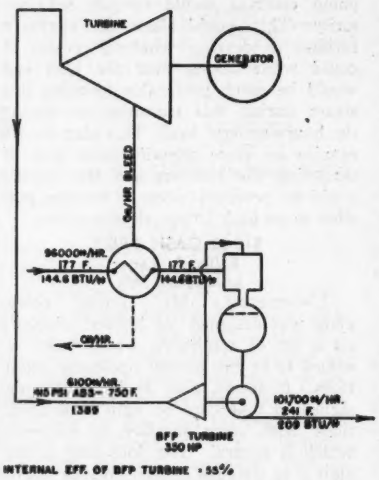
Under normal operating conditions with his motor driven feed pump running he has enough steam from the turbine bleed point to heat his feedwater. He is then operating his feed pump with a turbine electric drive in which he has an efficient seven stage turbine driving a generator which, in turn, supplies power to run the pump motor. If he were to use his turbine driven boiler feed pump he would have a relatively inefficient single stage turbine to drive it. Using the main turbine entails some generator and motor losses but even these are small enough so that a single stage turbine cannot compete. Fig. 2 shows this comparison diagrammatically.

The use of the motor driven boiler feed pump is, therefore, recommended whenever the load on the main turbine is sufficient to supply enough steam at the 7th stage bleed point to keep the feedwater tank at the proper temperature and pressure. A pressure gauge at this bleed point would give an immediate indication when the pressure is too low to provide the necessary amount of steam.

During light load operation the pressure at the 7th stage is so low that an insufficient amount of steam reaches the heater. Naturally, some heat has to be added from another source. Efficiency of a cycle is based on the amount of useful energy that can be derived and not on the ability of the cycle to reabsorb a part of its heat. Steam that is throttled dissipates energy which could be utilized. It is true that the total heat of the steam is the same before and after throttling but the available energy is not. A cycle's efficiency is measured by its ability to convert available energy into useful work. If any part of that available energy is wasted the cycle efficiency suffers. The fact that in Mr. Graves' plant there is no connection between the saturated steam line from the boiler to the feedwater tank is evidence that the designer did not intend to use live steam for feedwater heating. Mr. Graves' associates claim that he uses expensive superheated steam when using the turbine driven boiler feed pump while they are advocating the use of saturated steam from the boiler drum. The superheated steam has a greater available energy but it is utilized, at least to a great extent, for useful work in the cycle, therefore, it is being put to its best use. The saturated steam also has available energy though to somewhat less extent but this would be entirely wasted by throttling through the various valves if used for feedwater heating. The loss is in proportion to the difference in pressure before and after throttling. In this case, steam would be throttled from 400 psi down to somewhere between 5 and 40 psi.

Assuming, for instance, that the pressure in the feedwater tank is 20 psi ga. or 35 psi abs. and the steam from the boiler is 400 psi abs. and saturated (for easy reading of the Mollier diagram) the loss of available energy per pound of





Figs. 4 and 5. Drawings submitted by C.T.J.

steam used for feedwater heating would be:

For isentropic expansion	$h_1 = 1204$	
	$h_2 = 1022$	
	A.E. =	182
For throttling expansion	$h_1 = 1204$	
	$h_2 = 1204$	
	A.E. =	0000

Loss of available energy is 182 — 0 = 182 B.t.u. per lb. Obviously, live steam should never be used for feedwater heating or any other heating job in the plant where it can be avoided if the highest cycle efficiency is desired.

Mr. Graves suggests throttling the 7th stage heater when the exhaust from the turbine driven feed pump is too great but the load on the main unit is still too low for operation with the motor driven pump. This too will entail a small loss of available energy but the throttling will be between relatively close pressures and the amount of steam throttled will be a minimum. This represents the best use of the steam under the existing conditions and upholds Mr. Graves' side of the question. Mr. Corliss, who designed the Corliss valve mechanism for steam engines, sold his engines on a guarantee to save steam, which they did. Contributing to the success of his engine was the elimination to a great extent of the throttling and wire drawing inherent in the old slide valve engines.

Honorable Mention

So much for the prize winning letters. It need hardly be pointed out that despite their individual differences, the three prize winning contestants are fairly well agreed in regard to their fundamental philosophy of the situation. Simply stated it amounts to this, that it is not easy for the 500 hp. boiler feed pump turbine to compete with the 25,000 kw. generating unit operating in a regenerating cycle.

Aside from the prize winning letters a number of others deserve honorable mention. C. T. J. for example, whose letter follows and who asked that we publish only his initials, presented a most excellent analysis and as in the case of the prize winning letters, he also cautions Mr. Graves about throttling his extraction to make way for the exhaust steam. C. T. J. however, did not evaluate the heat balance relations as completely as did the other contestants.

C. T. J.'s Analysis

THE PROBLEM submitted by Mr. Graves goes back to the steam cycle fundamentals. Why has the regenerative cycle, bleeding steam from the main unit to heat the feedwater superseded the Rankine cycle with the steam from various auxiliaries heating the feedwater? The answer most commonly given (without resorting to mathematical demonstration) is that the regenerative cycle results in less heat being given up to the condensing water per unit output as part of the steam has 100 per cent of its heat utilized in work and heating feedwater, instead of giving up 75 per cent of its heat to be lost in the circulating water. This is of course perfectly true, but since electric driven auxiliaries must take the place of steam driven auxiliaries there is one more thing which must be remembered as contributing to the advantage of the regenerative cycle. This is the fact that the combined efficiency of the main turbine-generator and the auxiliary drive motors overmatches the efficiency of small auxiliary drive turbines. If this were not true we would see some heat cycles like Fig. 3. The lower internal efficiency of the small auxiliary turbines will result in less power being produced for a given feed temperature than that produced by expansion of steam bled from the main turbine at pressures equal to the exhaust pressures of the various auxiliary turbines. Since the amount of steam for feedwater heating is limited by the saturation temperature corresponding to boiler pressure the net result of using small auxiliary turbines will be a larger percentage of the total heat supplied being carried away by the condensing water. For purposes of comparison it is assumed that all power that can be produced by the auxiliary turbines is usable.

An illustration which will demonstrate the foregoing discourse (admittedly not too clear) and with conditions to fit Mr. Graves' specific problem is given in Figs. 4 and 5 below. Feedwater flow and steam conditions are reasonable assumptions while the assumed efficiencies are close to those actually found in practice. In Fig. 4 for simplicity the amount of steam bled is assumed to be only enough to generate the hp. required for the BFP motor (412 hp.) in its expansion to the 7th stage. In Fig. 5 the steam bled from the 7th stage is replaced by steam from the BFP turbine, with feedwater flows, etc., equivalent to Fig. 4. It is seen that the feedwater leaving the deaerator is at a temperature of 241 F. in Fig. 5 as contrasted to 215 F. in Fig. 4, which means that less steam will be extracted from the next higher heater (3rd stage) and more heat will be lost to the condensing water when using the turbine exhaust instead of extraction to heat the feedwater. Thus it would seem that Mr. Graves should be wary of throttling his extraction to make way for exhaust steam, as this is very likely to be a wasteful practice. A good thing to remember when dealing with the regenerative cycle is that anything which cuts down the amount of steam bled reduces the efficiency and the lower pressure the bleed point the greater the decrease.

No consideration has been given the possible loss sustained by radiation from the live steam line mentioned by Mr. Graves because he states that this line is always under pressure and therefore presumably hot (it should be trapped dry so it can supply steam immediately if it is for fire protection purposes). Under these conditions no additional heat will be lost by radiation from the line when steam is flowing through it. In any event, with 800 ft. of 1 in. pipe well insulated the loss will calculate to less than 5 cents per 5 hr. day with fuel at 15 cents per million B.t.u.

Of course to give Mr. Graves an accurate quantitative answer to his question heat balances would have to be worked out based on actual flows, steam conditions, etc., for the two different procedures. Mr. Graves does not supply enough information for this in his statement of the problem, but the foregoing may perhaps clarify the problem satisfactorily to him.

Other fine analyses were received from T. H. George of Oklahoma City, Okla., Charles H. Hathaway of Coronado, Cal., Barry M. Turner of Ticonderoga, N. Y., and R. C. Baker of Clearwater, S. C. Space is not available to present these letters or even to comment on them in this issue but they will be considered in the next issue.

On the whole, Mr. Graves should profit from these discussions but he alone knows all the intricacies of his plant and he alone must decide how to operate it.

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"Since using #7-AF here, there has been no carryover of any kind. The dosage is ½ grain per gallon. They are carrying the heaviest load in their history right now."— **A Meat Packing Plant.**

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"We have had absolutely no sign of carryover and absolutely no superheater trouble since we began using the #7-AF. Previous to the use of #7-AF we have always had trouble getting the operators to use aftertreatment, and now we are having much trouble in keeping them from using too much."— **A Steel Plant.**

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LETTERS AND COMMENTS

Another Phosphate Control System

IN THE DECEMBER issue of POWER PLANT ENGINEERING there is an article by J. W. Odlum, p. 70, on Making a Phosphate Control System work.

Mr. Odlum's solution to his problem is very ingenious, especially the spark plug arrangement for indicating a weakening of his phosphate, but I think the entire system is more complicated than is required for doing the work. Also, in our case at least, the first cost was much greater and we wasted a lot of chemicals as the device furnished to indicate solution weakening was very erratic in operation.

We formerly used a tank arrangement with its numerous valves such as described in the article. We had all the troubles Mr. Odlum enumerates, as well as a few special gremlins of our own.

With our tank were furnished gage glasses, inside of which there were specific gravity bulbs. These bulbs were supposed to indicate weakening of the solution fed. The operators never had any confidence in these bulbs as most anything, such as a pressure change, (temperature change, the tank would be warm, the gage glass cool) or any tendency of the bulb to stick would cause the bulb to give a false indication.

We ran a number of simple evaporation tests on the solution in our tanks after the bulb showed depletion. These tests showed we averaged a loss of 4 per cent in chemicals by relying on the bulb.

Explaining the System

Our next problem was trying to explain to a new man how the tank arrangement worked. Since there were so many valves, I doubt seriously if more than half the men who operated the feeders knew just how they worked.

In the past we used two tanks, one at the boiler house, the other at the process plant about 1000 ft. away. Caustic soda and phosphate were fed continuously into the hotwell at the process plant by means of a pressure tank and needle valve control. Differential pressure was created across the feed tank by means of an orifice in the make-up line.

We fed the caustic and phosphate continuously so as to protect the return line as much as possible, for the make-up water had its normal oxygen content and at one time ate up this line rather fast. We were cautioned against feeding continuously but we took a chance, simply because we knew the pipe would have to be replaced at an early date unless something was done to slow up corrosion. That was over 6 yr. ago now. We have never had any trouble. Extremely soft water may be the answer. The return has also stopped rusting away.

At the boiler plant we added to our boiler feed pump suction, by means of the second tank, tannin and sodium sulfite. These chemicals were added after the deaerating heater in order to save chemicals, as we depended on the heater to drive off most of the oxygen. The sulfite was used simply as a scavenger. The tannin, which we have been using experimentally as a protection against embrittlement, and which has an affinity for oxygen, was also added at the pump suction.

Results Are Different

We now feed our chemicals at the same places as before but the manner in which we feed them has made a world of difference.

At the process plant, we have an open steel tank 36 by 36 in., a solution basket, an all iron strainer and a chemical proportioning pump. There's nothing complicated about this. Anyone can see when the tank is full, low or at any stage in between, and there's no doubt about it. A man who has never seen a boiler plant can weigh out and dissolve the required chemicals. No valves to touch unless you count the water faucet filling the tank.

For the sulfite and tannin we use an open wooden tank, having a suction connection in the bottom, with a sand and gravel strainer setting over this opening. A low solution alarm on the tank notifies the operator in time to prevent the possibility of the tank going dry and thus pumping air into the suction of the boiler feed pumps, by means of the chemical proportioning pump.

One of the men thought of putting 1 in. of granulated cork in the sulfite mixture. This was done with the idea of preventing absorption of oxygen from the air by contact. We haven't checked to see what good it does. At least I'm sure the cork follows the solution up and down, doesn't hang up and cause trouble.

Over a period of 12 yr. we have tried three different methods of feeding chemicals. Of the three, the chemical proportioning pump gives the best results so far as control and feeding chemical is concerned. It is also the simplest, most foolproof and in the long run the most economical. I also believe that by proper pump selection, the pump installation is flexible enough to apply to any feedwater treatment problem.

If chemicals must be applied by the "shot" method, a large capacity pump plus an electric timer should do the trick.

In some cases a contact making feedwater meter may be indicated.

The best compliment I can pay our present arrangement is to say "If we had it to do over we wouldn't even look for anything better than what we have."

Clearwater, S. C. R. C. BAKER

A Born Collector

DEAR ED. You will probably call me a nut on the subject but I should worry. I have just been looking over my collection of slide rules and calculators and was quite amazed at their variety and usefulness. Today, I received from General Electric a new "Motorule" and to say the least, it sure is a whiz for the purpose. It is made to determine the motor horsepower required for metal-cutting operations. Boy, what a time saver it is! With it comes a book with some very valuable data in it; I don't see how they can do it, free.

Some of the older ones in my collection are as follows:

Bull Dog Electric Products Co. "Motor and Wire Data" giving all necessary data on wire, amperes, area, conduit size, maximum run full load with 2 per cent voltage drop; also wire sizes for rubber covered, slow burning, circular mills, 2, 3, 4, 6, wires, and different voltages, as well as a lot of very good data on motor wire work.

Next is a circular slide rule put out by L. S. Starret giving decimal equivalents for various fractions, size of tap, threads per inch, size of tap drill.

Also on the list is a circular slide rule put out by National Union Radio Tube Co. and it gives the correct hook up for a lot of the older type tubes. I paid 25 cents for that one years ago.

I also paid 25 cents for the Ohmite ohms law calculator with which I can figure out the required dope on all resistors used in radio work. One side is for 1000 ohms to 10 megohms and the other side is for up to 1000 ohms, a very valuable rule.

Next I received, lately, a Burgess snubber calculator which is a peach for figuring out intake snubbers for air compressors and exhaust snubbers for Diesel or gas engines. Snubber is a new name for muffler.

Also in the kit is a new General Electric Wirometer which is also a wonderful time and nerve saver. It has slides for the following six types of wire and compared with the latest data is very accurate. Types of wire are R, RHT, RPT, RU, bare conductors and SN.

A lot of time can be saved with these various rules but there are cases where the head must be used also. These rules with a good log duplex rule are a help to any engineer whether he is running, erecting or designing.

Buffalo, N. Y. ROBERT BAKER

AVOID this Costly Valve Leakage

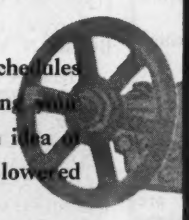
AREA OF LEAK	AIR		STEAM		WATER	
Diameter Inches	Number of cubic feet per month at 75 lb. pressure	Total cost of waste per month 11c per 1000 cubic feet	Pounds wasted per month at 160 lb. pressure	Total cost of waste per month 65¢ per 1000 lb.	Gallons wasted per month at 60 lb. pressure	Total cost of waste per month 16c per 1000 gallons
1/2"	13,468,000	$1,481.44	1,219,280	$792.53	1,524,100	$243.86
3/8"	7,558,500	831.44	684,290	444.79	853,360	136.86
1/4"	3,366,990	370.37	304,820	198.13	381,020	60.96
1/8"	824,570	90.70	74,650	48.52	93,310	14.93
1/16"	213,000	23.43	19,280	12.53	24,110	3.86
1/32"	52,910	5.82	4,790	3.11	5,990	.96

Enlarged copies of this chart available on request; also for Lunkenheimer Catalog

Valves aren't easy to replace these days . . . practically all materials going into their manufacture are on the critical list. This means that it is up to every valve user to take the best care of what he has, to insure the longest possible service life.

Leaky valves are saboteurs of your production schedules . . . obstructing your best efforts and increasing your costs. The chart illustrated above gives you an idea of what valve leakage costs you, not to mention the lowered efficiency of your operations.

Fortunately, valves respond to good treatment. Careful handling, immediate repair of the slightest leaks, and prompt replacement of worn parts will keep them on the job, ready to meet the demands imposed by industry's unprecedented war effort.



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BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S.P.; BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

Questions And Answers

Question No. 225

How Big Should a Blowoff Tank Be?

Is THERE any general rule for figuring the size of a blowoff tank for a particular boiler or battery of boilers?

St. Louis, Mo. A. W. C.

A. WE HAVE already referred the above engineer to two published comments on this question. The first, from POWER PLANT ENGINEERING'S Questions and Answers, page 58, states that it is usual to provide in a blowoff tank about 1/24 the volume of the boilers to be blown off into it simultaneously. The second comment is found on page 729, Piping Handbook, Walker & Crocker, 3d Edition. This states first that the size of the tank is of little importance *provided* the overflow pipe is adequate in diameter and elevation above the sewer to handle the total amount of blowdown and cooling water. However, if a drain large enough to handle this rate of flow cannot be provided, the tank must be made of dimensions ample to accommodate the blowdown and cooling water collected during the blowing down operation of one valve. The tank contents can then be allowed to drain off before blowing the next valve.

Have readers any further comments?

Question No. 226

Why Do Fans Act This Way if Discharge Is Obstructed?

SOME of the questions you get are as bad as some I get from the embryonic machinist's mates at the Naval Training School. Maybe some reader can explain why a centrifugal fan loses its load when the discharge is obstructed and why a propeller type fan increases its load under the same conditions. I can explain it by using the characteristic curves for either type but that method means less than nothing to the Navy lads. Can somebody explain it some other way?

Melrose, Mass. MALARKEY

Answer No. 196

Any Old Timers Know About Hot Air Engines?

In the November issue, W.E.H. stated that he had found in his store room a size 8, Rider Ericsson hot air engine in excellent shape. He asked, "What oil should it be lubricated with, what are its strong and weak points, what power will it develop and is it worth while trying to make use of?"

The first comment came from W. E. S. Dyer and his letter, together with some of the material from Mark's Handbook that he refers to, is given below. Then for a time there was silence.

This was finally broken by a letter from J. V. O'Neill of Walden, N. Y., who sent three interesting booklets published by the Rider Ericsson Engine Co. of Walden, giving some data on the engines together with directions for operating them, with the suggestion that these booklets be sent along to W.E.H. Before doing this we abstracted some of the information which is given below.

Dyer Tells What Oil He Used

In your November number under question No. 196 W.E.H. inquires about a Rider-Ericsson hot air engine. About 40 yr. ago I had a couple of these units pumping a feeble stream of water for domestic purposes. As to the lubrication, we used a very thin oil on the cylinder wall and ordinary engine oil on the main bearings and connections. Tell W.E.H to look on Page 1251 of Marks Handbook—1930 issue—and he will find a reference to the Rider unit.

Buffalo, N. Y. W. E. S. DYER

Here are the important points brought out in the above mentioned item from Marks Handbook:

"Their bulk per horsepower capacity is great as compared to steam or gas engines and their efficiency is low. They find use, however, in small sizes for domestic pumping work." In a table included with the above comment, data are given for several hot air engines. One of these, known as the Buckett engine, with a cylinder of 24 in. diameter and 16 in. stroke, at 61 r.p.m. developed 20.2 I.hp. and 14.4 B.hp., consuming 1.8 lb. of fuel per I.hp. and 2.5 lb. per B.hp. A Rider engine, with a 6.7 in. diameter cylinder, 9.5 in. stroke, at 138 r.p.m. develops 0.81 I.hp. and 0.23 B.hp. No data are given on fuel consumption.

Extracts from the Rider-Ericsson Pamphlets

"These engines are designed to pump water from surface wells, deep wells, streams and lakes, to force water to the upper floors of houses where local pressure is insufficient, to fill elevated tanks and pneumatic tanks for ever-ready supply in the home, ranch, factory, farm or irrigation work. Our equipment will furnish from 50 to 2800 gal. per hr. and can operate up to 300 ft. vertical lift and 350 ft. vertical discharge. Greatest total head of lift including discharge is 500 ft.

"The operation of these engines is extremely simple. The only requirement is to light and maintain a fire of sufficient intensity. For this purpose any known fuel can be used such as coal, wood, coke, gas, oil, dried cane, camel dung or other material which will support combustion. Anyone capable of maintaining a fire can run the engine." The best coal to use is anthracite, chestnut size. Any kind of wood may be used for fuel and it is difficult to damage the machine by overheating with this fuel. With other fuels, however, care must be taken not to overheat the bottom of the engine. This part should not be heated above a dull red heat.

One instruction book, apparently the older one, says "Never use lard oil or any gummy oil. An excellent mixture is a compound of paraffine and sperm oil in the proportion of two parts of the former to one part of the latter." The other publication says, 'All the working parts of these machines need a few drops of oil every time the engine is run. Do not use much oil on the cylinder. A swab is furnished with every engine and should be used for oiling the inside of the cylinder instead of applying the oil from the squirt can. A few drops of oil should also be put around the transfer piston rod where it works through the leather packing." The latest word on the subject is as follows:

W. E. H. Gets It Running

I appreciate very much the circulars on the hot air engine. You may be interested to know that I have overhauled the engine and it seems to go perfectly. I am doing this more or less as a hobby and really consider it a museum piece more than a practical machine.

W. E. H.

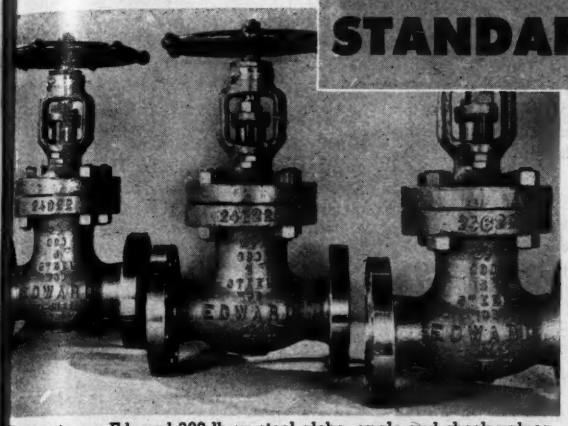
Answer No. 202

Should He Reduce the Speed of His Engine?

SEVERAL ENGINEERS have ideas about whether L.M.J.vL. can and should reduce the speed of his engine to reduce its steam consumption. You remember that in the Dec., 1942 issue he stated he had a 50-yr. old, 13 by 19-in. slide valve engine, running at 100 r.p.m., taking steam at 125 lb. ga. and exhausing at 5 lb. ga. He wanted to know if he ought to reduce the speed to 68 r.p.m., changing pulley sizes, of course, because the engine must drive a line shaft at 250 r.p.m.

Among other things L.M.J.vL's engine is not equipped for an indicator and most of the commentators stressed the point that indicator cards would be very helpful in this case. Careful attention to a number of factors other than the speed are suggested to reduce the steam consumption. Also, the point is raised that since lowering speed would decrease power, the thing to do is to raise the speed. Why? Well, read the following comments and see for yourself.

Cut Delivery Time with These STANDARD EDWARD VALVES



It pays to use Edward 300 lb sp steel globe, angle and check valves. Note strong, functional design of 2½ in. cast steel globe stop valves above. Fully guided disk permits installation in any position.

Choosing these standard Edward valves means quicker delivery. But important as that is today, there are other big dividends—such things as maximum job and part interchangeability, easier installation and other time saving factors.

Built with the customary Edward emphasis on "plus value" construction, these versatile forged and cast steel valves fit a wide variety of power, petroleum, process piping and industrial services. For more detailed descriptions and dimensions see Edward Catalog No. 101. If you haven't a copy, a post card will bring you one by return mail.

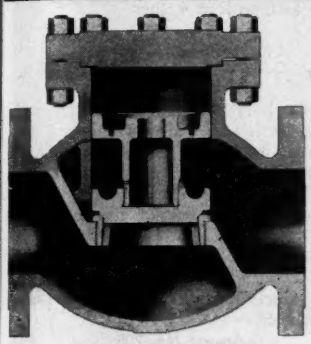


Fig. 6597—Horizontal

CAST STEEL CHECKS . .

For 300 lb check valve service, choose Edward Fig. 6597 (horizontal) or Fig. 6598 (angle). Cast steel, piston type, flanged ends, sizes 2½ in. to 12 in. Integrally cast ribs guide disk-piston assembly throughout travel. Streamlined bodies contoured for free flow. Also built for pressures to 1500 lb and in sizes to 12 in. Forged steel check valves, ¼ in. to 2 in. available.

Fig. 2698

SCREWED STOP VALVES

Edward screwed end stop valves, either inside screw (Fig. 2698-9) or O.S. & Y. (Fig. 2688-9) are going into all sorts of service today. Full area forged steel bodies minimize pressure drop. EValloy seats and disks. Drop tight closure. Globe and angle, for 600 lb sp in sizes ¼ in. to 2 in.

FLANGED STOP VALVES . .

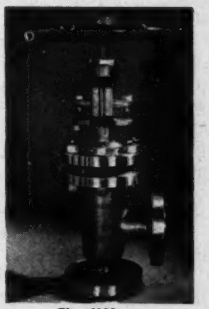


Fig. 4829

There's long, economical life in Edward globe and angle forged steel flanged end stop valves. Seats, disks and stems are EValloy, Edward's specially processed stainless steel. Unique swivel plug type disk design prevents galling. Heat treated forged steel bodies proportioned to reduce distortion under heat. O.S. & Y. with bolted bonnets and bolted glands. For pressures to 600 lb sp, sizes ½ in. to 2 in. Same design characteristics available in valves for service to 1500 lb.

INTEX GLOBE STOP VALVES . .

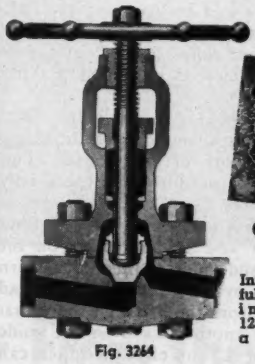


Fig. 3264

GET THIS FOLDER!

Intex valves are fully described in Catalog 12-G5. Write for a copy today!

Disks and integral seats of these Edward Intex valves are hard surfaced with Stellite. Disassembly unusually easy, working parts readily accessible. Socket welding, flanged or screwed ends for pressures to 1500 lb at 950 F.

BLOW-OFF VALVES . . . .

Edward blow-off valves are designed to avoid damaging shock to piping. Simple, frill-free construction with no unnecessary parts to erode or cause clogging. EValloy and Stellite seats and disks. Globe type seating for tight closure. Straightway and angle for 150 to 1500 lb sp service.

THE EDWARD VALVE & MFG. CO., INC.
220 W. 144th STREET • EAST CHICAGO, INDIANA

EDWARD Steel CAST AND FORGED VALVES

Indicator and Complete Engine Overhaul Will Help

BY REDUCING the engine speed the steam consumption will be reduced accordingly, but, as the writer says, he will have to change the size of the pulley on the line shaft to retain the present speed of 250 r.p.m.

The question then arises, will the engine, running at the reduced speed, develop sufficient horsepower to run the plant? A problem in heat balance.

At present the engine develops 65.5 hp. This will be considerably reduced when the speed is changed from 100 to 68 r.p.m.

First of all the cylinder should be drilled for indicator cocks and these fitted, as only by taking diagrams can one get a true analysis of the engine performance.

If unable to obtain an indicator I suggest that one may be borrowed from a local plant or possibly from one of the technical schools in the town.

Are the piston rings in good condition? Is the cylinder scored or out of true circle? What is the pressure at the exhaust opening point? Is the valve or cylinder face leaking? These questions can be answered by studying the indicator cards, otherwise one can just assume conditions or adopt some makeshift which is not good practice at any time.

Test the engine for cylinder clearance which is a very important factor in the economy of any engine. This is a simple procedure and takes only a few minutes.

To do this, turn the engine to either dead center and scribe a mark on the crosshead and guide at this point. Turn the engine over to the opposite dead center and from the mark on the crosshead scribe another mark on the guide in line with it. The clearance then can be measured between the mark on the crosshead and those on the guide at either end.

Any adjustment necessary can then be made by adding or removing shims between the crosshead or crank end bearings and their respective rod ends. Piston rod and packing should also be overhauled to insure a minimum of friction and still remain steam tight. Cylinder and steam pipe covering should also be overhauled and leaks stopped. Indicator cards should then be taken after the engine is put into good mechanical condition.

It may then be necessary to adjust the eccentric or change the slide valve to produce a card as nearly perfect as possible, by adding lap to, or removing lap from, the steam or exhaust edges of the valve.

If no indicator is available, I suggest that the engine be run at the minimum speed demanded by the equipment and the governor set accordingly.

It is also very important that the boiler pressure be fully maintained at all times, for a drop in the initial pressure means a very great increase in steam consumption.

Another important factor in this problem of steam consumption is the condition of the equipment being driven by the engine.

Make sure that there are no out-of-line shafts, unbalanced wheels, poorly lubricated bearings or other sources of friction, which in turn all add to the steam demand of the engine in question.

Kearny, N. J. GEO. MCNALLY

Increased Engine Speed Is the Answer, Says Bill Maddock

ASSUMING THAT the load on the ironers and washers is to remain the same, then the changing of the prime mover's speed will not reduce the load on the engine. Naturally, if the speed of the machines is reduced, (and it is presumed that such a move would cut the operating capacity), then the brake horsepower required would vary directly.

In checking the figures of 65 indicated horsepower he arrived at, I used the standard formula:

$$HP = PLAN \div 33{,}000$$

From this, he should have been able to see that a reduction in engine speed would mean an increase in the mean effective pressure to get the same output. To accomplish this, it would necessitate a higher back pressure, because the cut-off would be delayed. All this leads to more sensible heat loss in the exhaust, lower efficiency and a higher water rate.

The more reasonable thing to do, if the engine can stand it, would be to increase the engine speed without changing the speed of the load. By doing this:

1. M.E.P. would be reduced;
2. Cut-off will come earlier;
3. Back pressure should go down;
4. Sensible heat loss in the exhaust should be less;
5. Efficiency should show a general increase, offset a little by the increased friction losses.

Other general methods of decreasing the water rate are by superheating, higher boiler pressure, lower back pressure, overhauling valve gear, and reducing blow-by.

Hermosa Beach, Calif. BILL MADDOCK

Stop Losses Rather Than Cut Speed

A VALUE OF 65 to 70 initial horsepower is approximately correct for a 13 by 19 engine at 100 r.p.m., 125 ga. Since this is an old engine, it prompts the suggestion as to how much wear has the cylinder, piston, rings and valves undergone. The cylinder drain valves can be used to determine this leakage. Keep moisture in steam as low as possible.

It sometimes happens that line shafting is out of line, requiring considerable power needlessly, so that might be checked, also its lubrication. If you reduce the speed of the engine, you reduce its output and under heavy loads the job slows down. Laundries overload their equipment at times and a little extra power comes in handy in the rush to get done, so I wouldn't change the speed. True, some steam could be saved by slowing down a bit if you already have much excess power. Finding ways to use waste heat will reduce the boiler load and save fuel.

It should not be a hard job to drill and tap the counterbores for cylinder indicator cocks, if you need them.

Cincinnati, Ohio WM. E. RIXMAN

L. M. J. vL. has assumed 51.5 psi, m.e.p.; a table in Kent's Mechanical Engineers' Handbook, Vol. II, 1936 ed., Sec. 7—p. 11, gives 64 lb. for average mean effective pressures of commercial non-condensing single-valve engines. Theoretical m.e.p. can be calculated thus:

$$P_m = \frac{P_1 (1 + \log_e R)}{R} - P_2$$

Where: P_1 = initial steam pressure, psi. abs.
P_2 = back pressure, psi. abs.
R = ratio of expansion or number of expansions, $V_2 \div V_1$

If we assume $R = 4$, then

$$P_m = \frac{140 (1 + \log_e 4)}{4} - 20 = 54 \text{ lb.}$$

and the horsepower, recalculated with this figure is 68.5. However $R = 4$ may be much too high. Other data in Kent indicate that R might be anywhere from 2½ to 4. For an engine overloaded as this one is, he suggests a diagram factor $\frac{(1 + \log_e R)}{R}$ of 0.7 and shows a curve from which R figures out 3.1. So take your choice.

Answer No. 205

How Much Condensing Water Is Needed Here?

More Water Needed, Says Bill Maddock, Also May Be Air Leakage

TO DETERMINE the quantity of circulating water required by F. J. S's condenser, my experience has been that pump curves, weirs, velocity meters, or physical measurements will give very satisfactory results. However, he apparently would like some method that he could use based on heat load calculations.

Starting with this equation:

(1) Heat of steam — heat of condensate = heat to cooling water

(1a) [B.t.u./lb. steam — B.t.u./lb. cond.] × kw-hr. × lb./kw-hr.
= g.p.m. × 8.33 × 60 × rise in temperature

The easiest way is to assume that the net heat per pound of steam to the condenser is 96 B.t.u. This is sufficiently accurate for most condenser calculations and is certainly as accurate as the thermometer readings. In this way, for his 500-kw. unit at full load using 28 lb. per kw-hr., the formula is

$$96 \times 500 \times 28 = \text{g.p.m.} \times 8.33 \times 60 \times 40$$

$$\text{g.p.m.} = \frac{96 \times 28 \times 500}{8.33 \times 60 \times 40} = 670 \text{ g.p.m.}$$

More exact figuring can be done to get the heat input from steam conditions. Start with the total heat of the steam at

How to Repair Valves
Tips on Valve Trim
To Help Keep Piping On the Job
11 Simple Ways to Get Better Service From Piping Equipment
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For Victory's sake, faster training of workers for better maintenance of piping is a vital *must.* In "Piping Pointers," Crane Co. shares its basic information for that use, with all industry, and offers these bulletins free to any plant. Ask your Crane Representative or write direct for your supply. Crane Co., 836 South Michigan Avenue, Chicago, Ill.

ARMY E NAVY

CRANE VALVES

the throttle [184.7 lb. abs., 420 deg. F.] as 1226 B.t.u. per lb. The unit uses a net of 1/28 of a kilowatt-hour out of each pound of steam. Since the kilowatt-hour is 3412 B.t.u., this means that 122 are taken from each pound. But this is only about 90 per cent of the total given up to the turbine blade, the rest being lost in radiation and mechanical losses. Then for each pound of steam that started through it gives up about 136 B.t.u. This, subtracted from the total heat to start leaves 1090 B.t.u. to go to the condenser.

The inquirer said that the condenser gave 18 in. of vacuum and at this pressure the heat of the liquid alone is 137 B.t.u., but he mentioned 6 deg. under cooling, so use 131 B.t.u. as the heat of the condensate.

$$1090 - 131 = 947 \text{ B.t.u. per lb.}$$

Substituting this in the equation

$$\text{g.p.m.} = \frac{947 \times 28 \times 500}{8.33 \times 60 \times 40} = 662$$

This is less than 1½ per cent difference and most thermometers can't be read that close.

It is noted that the condenser has 850 ÷ 500 or 1.7 sq. ft. of surface per kilowatt capacity, which is not too low for this size unit. But with a rise of 40 deg. F., it will be difficult to approach even a reasonably good "Log Mean Temperature Difference" and a good vacuum. More water would seem advisable.

A large difference in the exhaust steam and condensate may and probably does indicate air leakage. In a "tight" system where economy of operation is the major consideration, the additional water costs can usually be justified that will bring the vacuum up to 24 to 26 in. of mercury. Over that, the increased costs of water will probably offset any gain in fuel economy from the better efficiency.

Lower temperatures in the condenser may also tend to reduce scale growth. Where the condenser is used primarily to recover the steam for boiler feed, it may not be feasible to try for high vacuums at the expense of more cooling water, but it will always be advisable to reduce air leakage to the lowest point.

Hermosa Beach, Calif. BILL MADDOCK

Answer No. 206

Corrosion of Turbine Oil Reservoirs

CORROSION of turbine oil reservoirs by water accumulating in the oil system due to steam leakage is a serious problem for J. T. In the December issue he said they had tried various methods of overcoming the trouble without success and asked if there is any way of treating the insides of the reservoirs.

Oil Companies Have Protective Tank Coating

J. T.'s CORROSION problem has been investigated by at least one oil company and a protective coating developed. Standard Oil Co. has a protective coating and I believe The Texas Co. has also developed one.

We have never had much trouble with corrosion in our turbine oil reservoir but we plan on applying this coating as a safety measure when we can spare the unit long enough.

I suggest that J. T. contact the oil companies. They will solve this problem at a very reasonable cost.

Clearwater, S. C. R. C. BAKER

Look for Oil Cooler Leakage, Says Bonnett

BACK in 1936 we were bothered with water seeping into the oil of a Moore low-pressure turbine equipped with an Andale oil cooler.

Upon cleaning the oil cooler, we noticed oil seeping into the water tubes through the seams. Six new cores failed to correct our trouble.

Our chemist made an analysis of the water and found elements detrimental to brass in our water supply.

Upon receipt of the chemist's analysis, the Andale Cooler Co. sent us a copper core for our cooler which up to the present time has functioned perfectly.

Terre Haute, Ind. EDMUND J. BONNETT

Answer No. 208

Removing Sludge from Refrigerating System

WHEN YOU want the straight dope on refrigeration equipment and its operation—le veritable McCoy, as the French used to say—you can do no better than to get hold of George Holman. When F. McI., in the December issue, asked the cause of sludge in a refrigeration system and how to prevent it, we were pretty certain we'd hear from George about it. Sure enough.

George Holman Says Use Proper Oil, Also Get System Clean

F.McI. DID NOT MENTION the kind of refrigerant used in his system. Assuming that the refrigerant is ammonia, the sludge formed may be due to the use of a compound oil in the compressor. Nothing but a pure mineral oil should be used in an ammonia compressor, for any oil containing vegetable or animal fats or oils will saponify with ammonia and a sludge will be formed. This refrigerant is a caustic, much like common lye in its effects on organic matter.

If the sludge is caused by the use of a compound oil, it will be found in the compressor crankcase as well as in other parts of the system, and will be accompanied by sticking of the valves and piston rings, by clogging of the oil system and perhaps by burned out bearings.

However, sludge may form in an ammonia system even when a pure mineral oil of known characteristics is used as the lubricant. Several things may cause sludge formation in such cases. Water entering with the air whenever the system is opened for inspection or repair, or through an external lubricator, is a common cause. Since ammonia is hygroscopic, moisture from the atmosphere may accumulate in the system, although the air it enters with may be purged. This water emulsifies with any oil circulating with the refrigerant, and a sludge is formed.

In systems of refrigeration used for quick or sharp freezing, it is necessary for the operator to choose an oil with a low congealing temperature, in order to prevent clogging of expansion valve orifices. With most oils used in refrigeration systems, however, the flash point and congelation point rise and fall in unison. The oil chosen because it will remain fluid enough to pass through the expansion valves of low temperature-pressure systems, is certain to have a low flash point, say 300 deg. F. or less. With discharge temperatures as high as 250 deg. F., and with the oil deteriorating with use, there can be no great factor of safety.

Not that the oil will actually flash in the compressor. There is usually too little air at any particular stroke of the piston.

Instead, temperatures at or near the flash point will cause the oil to decompose. Such decomposition probably is assisted by the presence of the refrigerant, air or other gases, water, or metal worn from the bearings or other parts of the compressor. Such substances probably introduce catalysis.

One of the best methods of preventing the breakdown of oil, with resulting carbon deposits on the discharge valves and sludge precipitation elsewhere in the system, is to hold a low discharge temperature and high suction pressure.

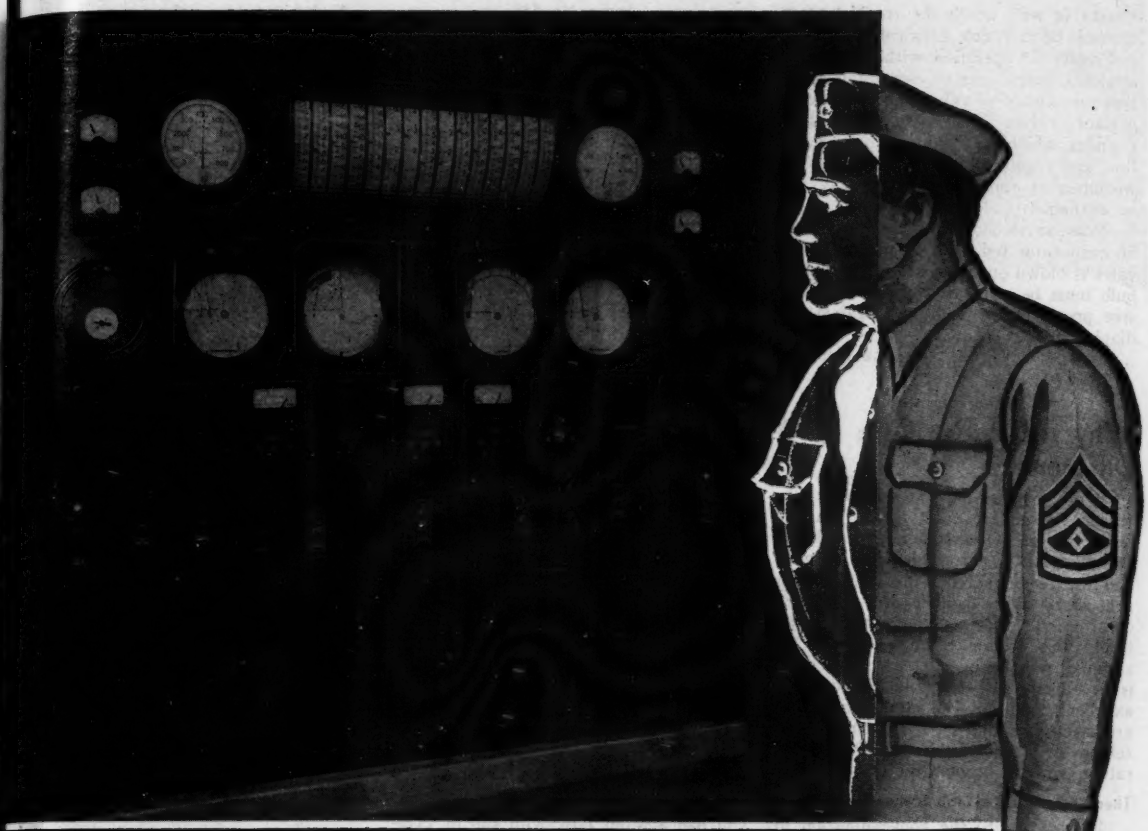
If F.McI. is using oil of proved characteristics, such as that which may be purchased from almost any reliable manufacturer of refrigeration machinery, his trouble is probably due to water. If it is practicable, the refrigerant should be bottled and shipped to the manufacturer for cleaning. Then while the system is empty, it should be cleaned thoroughly. The compressor should be washed out with gasoline or kerosene, although extreme caution should be practiced in the use of these highly inflammable and readily explosive fluids.

One of the best and quickest methods of cleaning condensers, liquid receivers, evaporators and piping systems is by blowing them out with steam. Here, again, an extreme degree of caution should be practiced, especially in removing the water after blowing. Also, evaporator pipes are usually welded; if steam is turned into a cold evaporator, water hammer may burst a pipe or crack a welded joint. The bursting by water hammer of an evaporator or piping system containing many bends is entirely possible even with the piping or evaporator open at both ends.

In threaded systems, heat will cause unequal expansion of the pipe and malleable iron fittings, with the result that the joints may leak. Gasoline, kerosene, carbon tetrachloride, etc., used inside a pipe, may loosen litharge at the joints, so that even cold cleaning has its hazards.

After cleaning, the system should be tested for leaks, as on installing. A little ammonia introduced into the system with the air used in the test simplifies the finding of any leaks. One per cent of the normal charge will suffice for this test, and to facilitate the locating of leaks is well worth while.

F.McI. may think that cleaning a system is a big job. It is. But a clean



The Ideal "TOP KICK"

Many an industrial commander, in these critical times, notes with keen satisfaction the smooth, well drilled performance of his steam power plant—and gives deserved credit to his "top sergeant": A Hays Combustion Control System.

Here, indeed is a seasoned, capable veteran, skilled at getting utmost efficiency out of the equipment he commands.

Automatically, "The All-Electric Way" Hays system controls combustion. It's made to do that. It regulates all combustion elements—measures each variation and corrects instantly—measures the correction: *maintains the right balance.*

With the nation's war effort putting extra demands on present steam power equipment, Hays Combustion Control Systems are doing an extraordinary job—stretching steam capacity, *safely;* getting the utmost out of existing boiler room equipment, *safely;* saving man-hours, saving operating costs.

To enlist this veteran in your own service, send for the Hays Combustion Control Catalog—it is full of pertinent steam-power data.

THE MODERN SYSTEM *It's Electrical*

HAYS *Automatic* COMBUSTION CONTROL

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system is well worth the trouble. Once cleaned, he can look forward to months and years of operation without clogged strainers, pump-outs to clean stopped-up thermo-expansion valves, sticking compressor valves and a hundred other troubles, which may suddenly halt operation and require the presence of skilled workmen at times when they may not be available.

Note on second paragraph above: If an evaporator fed by a thermo-expansion valve is blown out with steam, the remote bulb must be removed to prevent excessive pressure rise in it and against the diaphragm.

GEORGE HOLMAN

Answer No. 212

Why the Large CO_2 Difference?

WHY IS THERE such an enormous difference, asked H. Ettelt in the January issue, between Orsat readings of 13.5 to 14.2 per cent CO_2 from his boiler furnace and the readings from the stack gas, a foot ahead of the damper, of 9 to 9.5 per cent? Could he get them the same? Could the difference be traced to his steam atomizing oil burners? His boiler is a 3-drum bent-tube, oil-fired unit, in excellent condition (he says all air leaks are carefully caulked), stack temperature seldom over 460 deg. F. at 120 per cent rating, with no economizer or preheater.

There Must Be Leakage Somewhere

IN ANSWER to the above question in the January, 1943 issue, it is obvious that if the Orsat readings showing 13.5 to 14.2 per cent CO_2 in the furnace, are correct, there must be leakage somewhere since the CO_2 at the damper is 9 to 9.5 per cent.

If the average in the furnace is 13.8 per cent CO_2, the excess air with oil firing is approximately 10 per cent. If the average percentage of CO_2 is 9.2 per cent at the damper, the excess air at that point is approximately 63 per cent. This enormous increase of excess air must be caused by leakage in spite of the statement of Mr. Ettelt that even the smallest air leaks have been carefully caulked. I suggest that Mr. Ettelt should arrange to take CO_2 readings at various points between the damper and the furnace, traversing the setting from both sides. It is possible that the leakage may be found around the damper shaft.

The fact that the burners are of the steam atomizing type has nothing to do with the percentage of CO_2 that can be obtained, either with no excess air or with any given percentage of excess. The only difference between the burning of oil with steam atomizing burners and with mechanical burners is found in the slight increase in water vapor in the furnace or flue gas. In the case of steam atomization, there is a slight increase in loss due to this water vapor but, on the other hand, it has been my experience that steam atomization will give better mixing and therefore the burners can be operated with less excess air than the mechanical type.

Naperville, Ill. J. R. DARNELL

Answer No. 217

Is a 10-amp. Fuse Always a 10-amp. Fuse?

No! 1000 Times No.! Says Deichmann.

I do not agree with the answer to Hartmann's question. There is a difference in fuses rated at 10 amp. 250 v. and 10 amp. 500 v. My opinion is as follows: Amperes $\times$ volts = watts. 10 amp. $\times$ 500 v. = 5000 watts. 10 amp. $\times$ 250 v. = 2500 watts.

A 220-v., 15-amp. No. 12 wire will carry a 5-hp. motor. This same 220 v., 15-amp. fuse on 440 v. No. 12 wire will carry a 10 hp. motor. Rating of branch circuit, 45 amp. starting, 15 amp. running, on 220-v. 5-hp. motor. Rating on branch circuit 25 amp. starting and 7.5 amp. running on 440-v. 5-hp. motor.

The figures above are shown as an example. If you want to get the proper results out of a fuse, use it according to the label on it. There is a difference between 10 amp. 250 v. and 10 amp. 500 v. Put a 500-v. fuse on a 250-v. line and you will not get 10 amp. of current through it before it will blow. Or if you hook up two fuses in series, one a 10-amp. 250-v. fuse and the other a 10-amp. 500-v. fuse, and put them in a line at 250 v., the 10-amp. 500-v. fuse will blow first and if you put the same in a line of 500 v., the 10-amp. 500-v. fuse will still blow first. Why? The higher the voltage, the smaller the line.

Volts are pressure. The higher the water pressure, the smaller the line. If you had a water hose with 250 lb. pressure on it, and you were getting 10 bbl. per min. and if you raised from 250 lb. pressure to 500 lb. pressure, you get almost twice as many barrels. Same thing goes vice versa. If you were getting 500 lb. pressure and you get 10 barrels and you cut pressure down to 250 lb., you would get less than 10 barrels through it.

New Orleans, La. GEORGE DEICHMANN
Falstaff Brew Plant No. 4

The electrical editor, who wrote the answer published in February, still maintains he was right. What do other readers think? Go it, wife! Go it, b'ar!

Answer No. 220

What Makes the Marks on the Collector Rings?

EVERY TIME O. V. D. took one of his 2000-kw. or 3000-kw., 2300-v., 60-cycle separately excited a.c. generators out of service, he said in the March issue, they found a discolored smear on the collector rings. There was a smear for each brush, starting just the size of the brush, running about one-third the way around the ring and dragging out to an uneven ragged end. Excitation is not opened until the machine stops; oil circuit breakers not opened until watt-hour meter shows unit completely unloaded. What makes the marks?

It's the Exciter That Does It, Says D. L.

THE TROUBLE O. V. D. has with his rings is caused by leaving his field "on" after the machine comes to rest. If the exciter were on the same shaft with the generator, it would cease to generate, of course, when the shaft stopped rolling and if his field breaker were open or closed nothing would happen to the rings. But he has separately excited machines.

His exciter is probably about 110 v. and when the turbine slows down and stops, the amperes may build up to about 300. That would amount to over 30 kw. being dissipated into heat energy at the point of highest resistance in the circuit —that portion of the ring next to the brushes. The smear effect is caused by the burning of the ring, "starting just before the turbine comes to rest."

O. V. D. should run all the resistance "in" with his field rheostat and open his field breaker before his turbine stops rolling.

It is good practice to remove the field and prevent the field acting as a brake, for another reason. Removing the braking action of the field will permit the turbine to roll for a longer period before coming to rest and the turbine spindle cools off evenly and doesn't warp. This cuts down vibration when bringing machines up the next time.

I know what O. V. D.'s trouble is because I had the same experience.

Evansville, Ind. D. L.

McNally Says Marks May Be Caused in Starting Up

ANY MACHINE standing idle for even a short period will collect a certain amount of dirt or dust on the rings. Even though this little amount may seem negligible, it may just be sufficient to cause the marks in question to appear on the rings. It is my opinion, therefore, that the marks on these rings are not started when the oil circuit breaker is opened and the machine being taken *out* of service, but rather this is caused when the unit is put *into* service.

The diagram shows that it takes only a fraction of a revolution to clear the cause of the arc and that the ring surface further on becomes normal and smooth. The explanation is that the small amount of dust on the collector rings in starting is deposited under the brushes and is retained there until the field switch is closed, when an arc is produced by the burning of this dust. The marks on the rings will be slight or deep according to the intensity of the arc, which is, in turn, dependent on the dust composition and the voltage at which the field switch is closed.

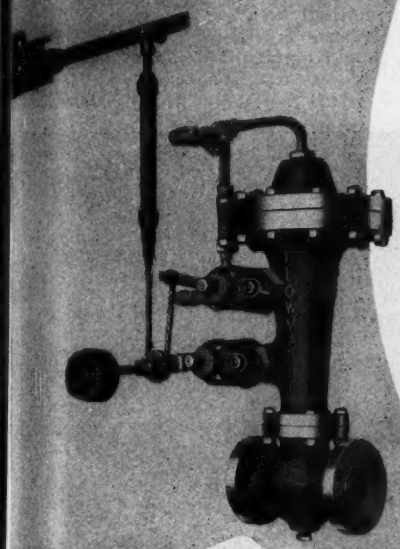
I suggest that O. V. D. wipe the rings clean immediately before the machine is started for service, using a clean rag and tetrachloride for this purpose. Then, in taking the unit out of service, after the oil switch is opened, run the field rheostat in until the voltage is at a minimum and pull the field switch while the machine is still rolling.

The marks may be caused when the machine is taken out of service, as O. V. D. suggests. This would quite possibly be caused by allowing the unit to come to rest before pulling the field switch, thus allowing the field current to flow through the rings at one point while the switch is opened. This would possibly cause an arc of sufficient intensity to mark the rings and would be greatly increased if no discharge resistor is fitted in the circuit, which is unlikely.

Kearny, N. J. GEO. MCNALLY

PRICE

IS WHAT YOU PAY
VALUE IS WHAT YOU
GET---



COPES Flowmatic, the steam-flow regulator, is designed to protect a boiler, not to meet a price. In first cost Flowmatic may cost you more dollars than any other regulator on the market. However, shrewd engineers and operators add up the savings and performance offered by Flowmatic and soon write off its price in a few months of service.

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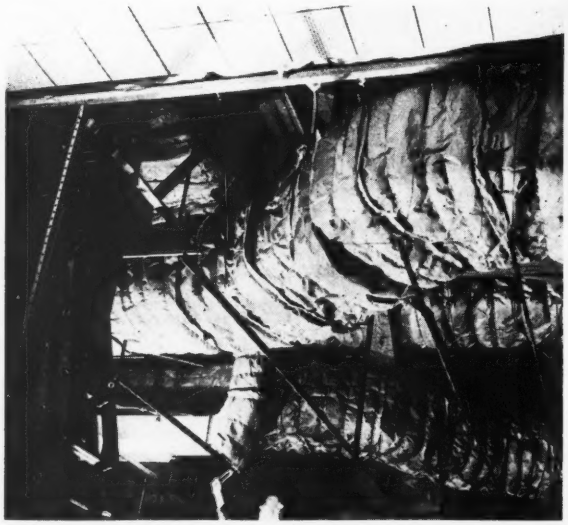
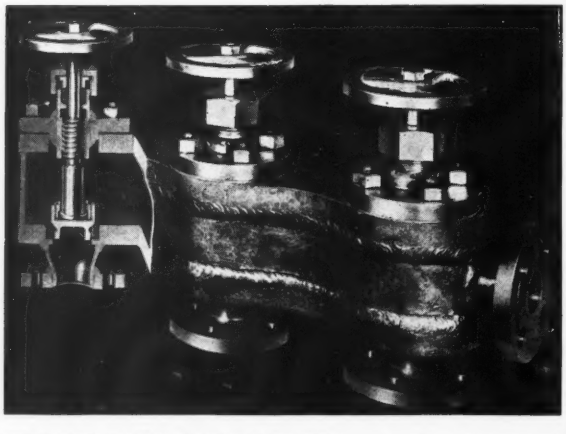
SHOP TALK

A department showing by means of photographs how engineers in various plants have overcome certain obstacles or devised methods to facilitate operation. If you have done something along similar lines that you are proud of or which you feel may be of interest to others, send us a picture and a paragraph of explanation. If the photograph is good and if the idea is original we will present it on this page and pay you for it

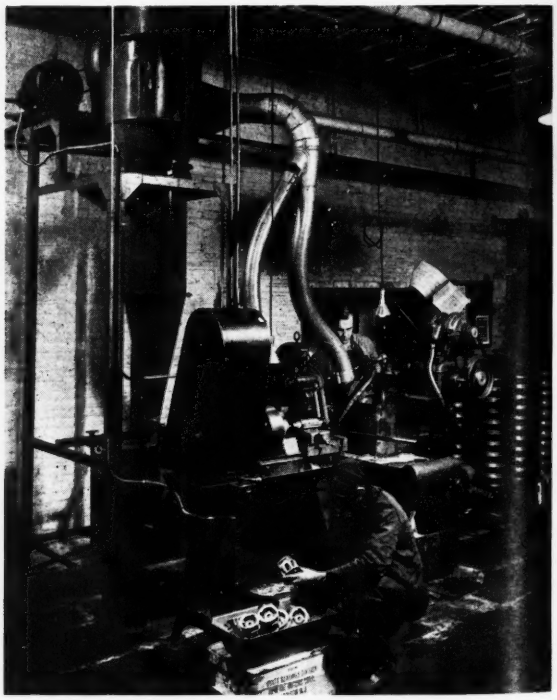


DUCT INSULATION. Rock wool bats being applied to the air conditioning ducts of a California aircraft plant. The insulation is first well covered by heavy paper and then held firmly in place by numerous tightly twisted wire bands.

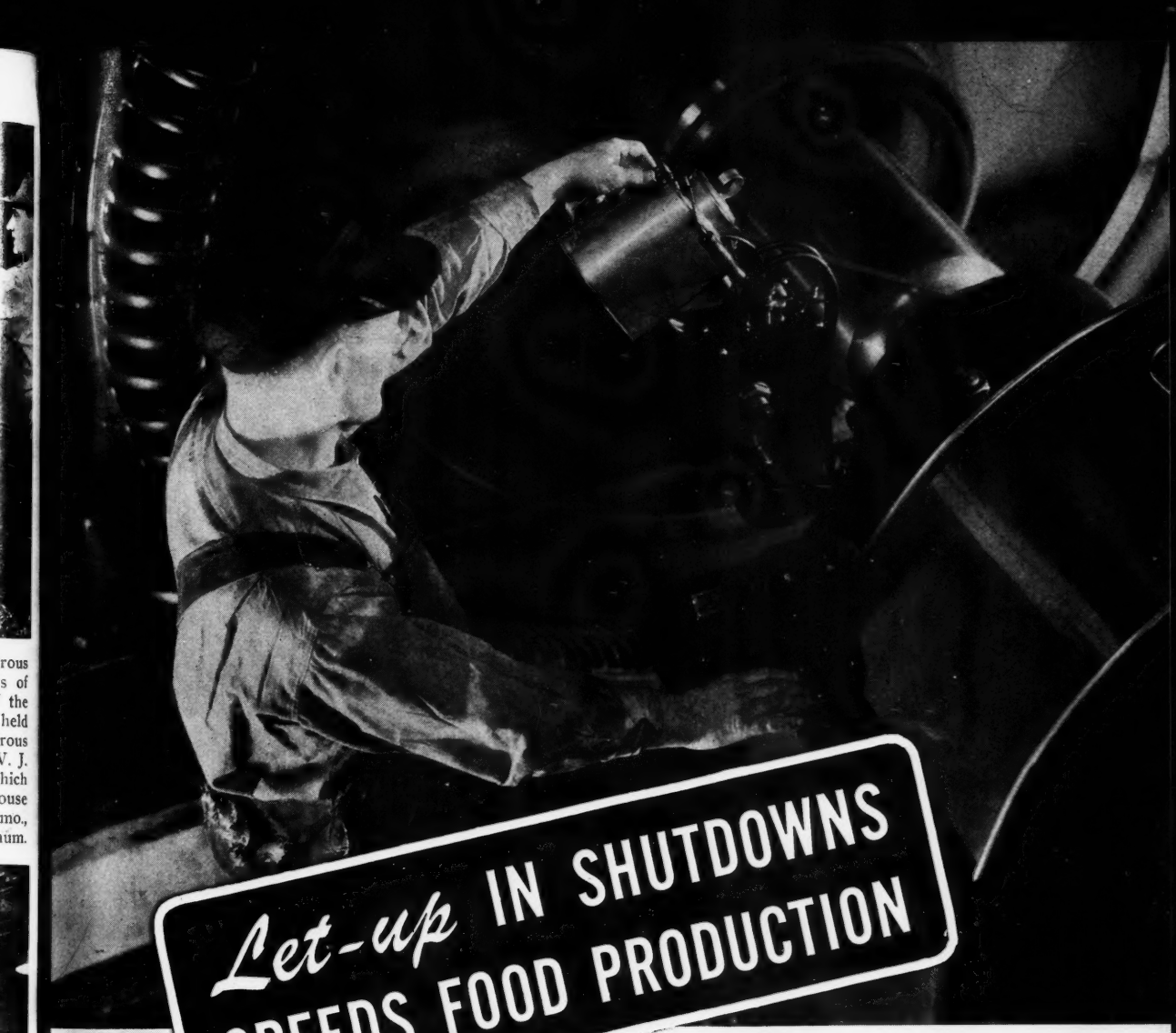


WELDED MANIFOLD VALVES. The simplification of valve-and-piping hook-ups is made possible through the use of welded manifold valves, as manufactured by Zallea Bros. & Johnson, Wilmington, Del. Any number of valves of any type in any size, of carbon or stainless steel, chrome iron, nickel, monel or other alloys can be combined in an integrated unit to meet any requirement. Advantages include greater strength with less weight, space economy, ease of installation, minimum pressure drop, the elimination of bolts, gaskets and flanged fittings between the valves.

SCRAP RECOVERY. Separating iron from non-ferrous scrap at the Westinghouse Linehart Works by means of a magnetic separator. The pulley on the upper end of the belt is strongly magnetized and the iron scraps are held on the belt and carried to the under side. Non-ferrous scraps are discharged directly to a box. According to W. J. Laird, head of the Reclamation Division at this plant, which receives machine shop remnants from all Westinghouse plants, non-ferrous recovery runs about 600 tons per mo., about 60 tons of which is vitally needed aluminum.



CONTROLLING INDUSTRIAL DUST. Dust is a hazard to health, tools and good workmanship and present industrial standards call for its control wherever possible. The above photograph shows a (American Foundry Equipment Co.) cyclone dust collector used in a prominent manufacturing plant for collecting the dust from two high-speed grinders. In this particular installation an air volume of 100 c.f.m. is being exhausted in removal of the dust.



Let-up IN SHUTDOWNS SPEEDS FOOD PRODUCTION

SOLNUS OILS

reduce Diesel "down-time" . . . save 50% for food processor

Unfailing power must be maintained to turn the wheels of America's war industries faster. And here's how an eastern food processor achieved this goal!

Frequent shutdowns for repairs, sticky valves, and failure of the oil to hold up under running conditions were causing power interruptions and delaying production. So a lubrication expert was called — a Sun Oil "Doctor of Industry." He studied the operating conditions and recommended Solnus Heavy Medium Oil. The change was made. Now valves no longer stick, engine runs smoother, and there have been no forced shutdowns! Samples tested show that Solnus Oils hold up better . . . in fact, operating time between oil changes had been increased 50%. Oil and time are saved.

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Call in a Sun Doctor of Industry today to aid you in your battle for increased production. Write

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SUNOCO

SUN PETROLEUM PRODUCTS *HELPING INDUSTRY HELP AMERICA*

(*Continued from Page* 84)

Fig. 3. Lt. Col. Louis C. McCabe (left) and J. A. Heffernan, both of the Office of the Chief of Engineers, U. S. Army, who spoke at the Army Engineering Hour, Midwest Power Conference, April 9, 1943

tors as insufficient combustion chamber cubage, absence of adequate coal and ash handling facilities, lack of chimney capacity to overcome fuel bed resistance although satisfactory for oil firing, lack of labor for manual firing, political likes and dislikes, ownership difficulties were among some of the factors discussed by Samuel I. Rottmayer, mechanical engineer of Chicago.

Automatic Control

Use of Automatic Control to Increase Plant Capacity was discussed by H. H. Gorrie of Bailey Meter Co. He called attention to the functions of automatic combustion control in supplying fuel and air in correct amounts and ratio for maximum fuel economy. Simplified operation and more efficient use of personnel, increased life of boiler and auxiliaries, improved prime mover efficiency, maximum boiler output and protection against accidents and shut downs all resulting from automatic control were also discussed in detail.

Diesel Power

Analysis of the technical developments leading to the present types of heavy-duty stationary Diesel engines was given by B. V. E. Nordberg of Nordberg Mfg. Co. An abstract of this will appear in a future issue.

Effect of Fuel Composition on Deposition in Diesel Engines was the subject of a paper by L. E. Hebl and L. W. Griffith of Shell Oil Co. Piston ring sticking, cylinder scuffing, sludging and bearing failures and the like have occurred in small bore high-speed Diesels such as are used in automotive work. Lubricating oils containing detergents were developed to prevent deposition, allow long periods of operation before overhaul becomes necessary. Such lubricants are expensive, but they reduce operating and maintenance.

The speakers then presented details of tests indicating that the fuel was a major factor in piston skirt and ring belt deposits. However, they found usual inspection properties of a fuel would not predict its tendency to produce ring belt and skirt deposits. A portion of the effort now being applied to develop better lubricating oils might well be devoted to improvement in fuels and in engine design.

Electrical Distribution

In a paper on Resonant Ground for Long-Distance Power Transmission Systems, W. A. Lewis of Cornell University gave a thorough analysis, both mathematical and non-mathematical, of a resonant-grounded system, sometimes known as Petersen coil or ground - fault - neutralizer systems.

Application of Shunt Capacitors to Meet Emergency War Conditions, a subject familiar to readers of POWER PLANT ENGINEERING in recent months, was discussed in detail by Chas. F. Wagner of Westinghouse Elec. & Mfg. Co.

To provide a guide to the literature of certain phases of low-voltage bus design, Thomas J. Higgins of Illinois Institute of Technology has assembled a complete bibliography of the literature, summarized the essential content of each item, subdivided the material and integrated the comments to achieve a coherent whole. All this was presented in his paper Design of Direct-Current and Low-Frequency Bus Systems—A Guide to the Literature.

In his paper, Wartime Industrial Power Applications of Electrical Equipment, D. L. Beeman of General Electric Co. gave details of selection of voltages, design of primary and secondary substations, circuit arrangements, feeders and the like, in industrial distribution systems.

To reduce distribution system copper, he advocates: 1, Use as high a voltage as practical, 13.8 kv. instead of 2.4 kv. or 480 v. instead of 208Y/120 and so on. (It often takes 3 to 10 times as much copper for a 2.4 kv. system as for a 13.8 kw. system.) 2. Locate substations at load centers to reduce secondary copper to a minimum. 3. Use small substations, i.e., 1000 kv-a. or less at 480-v. secondaries. The two foregoing factors, he says, will save 10 to 40 per cent of the copper. 4. Use high temperature cable insulation or open wiring. 5. Use the distribution system circuit arrangement which has the less copper content. 6. Select equipment that has the minimum copper content.

Water Conditioning for High Pressure Operation

Certain problems of water conditioning characteristic of high pressure operation were discussed in detail by D. B. Jones of Hall Laboratories, Inc., in his paper Guideposts on the High Pressure Road. Phosphate conditioning has been used as a preventive of calcium scales but will not eliminate scale formation due to evaporation practically to dryness, which occurs in water wall, slag screen and main generating tubes.

Means are available to reduce silica in makeup water to a low value but are costly. It may be less costly to set up a schedule of mechanical cleaning or increase steam generating equipment to permit operation at lower ratings. Finally, boiler design may have to be changed to increase circulation.

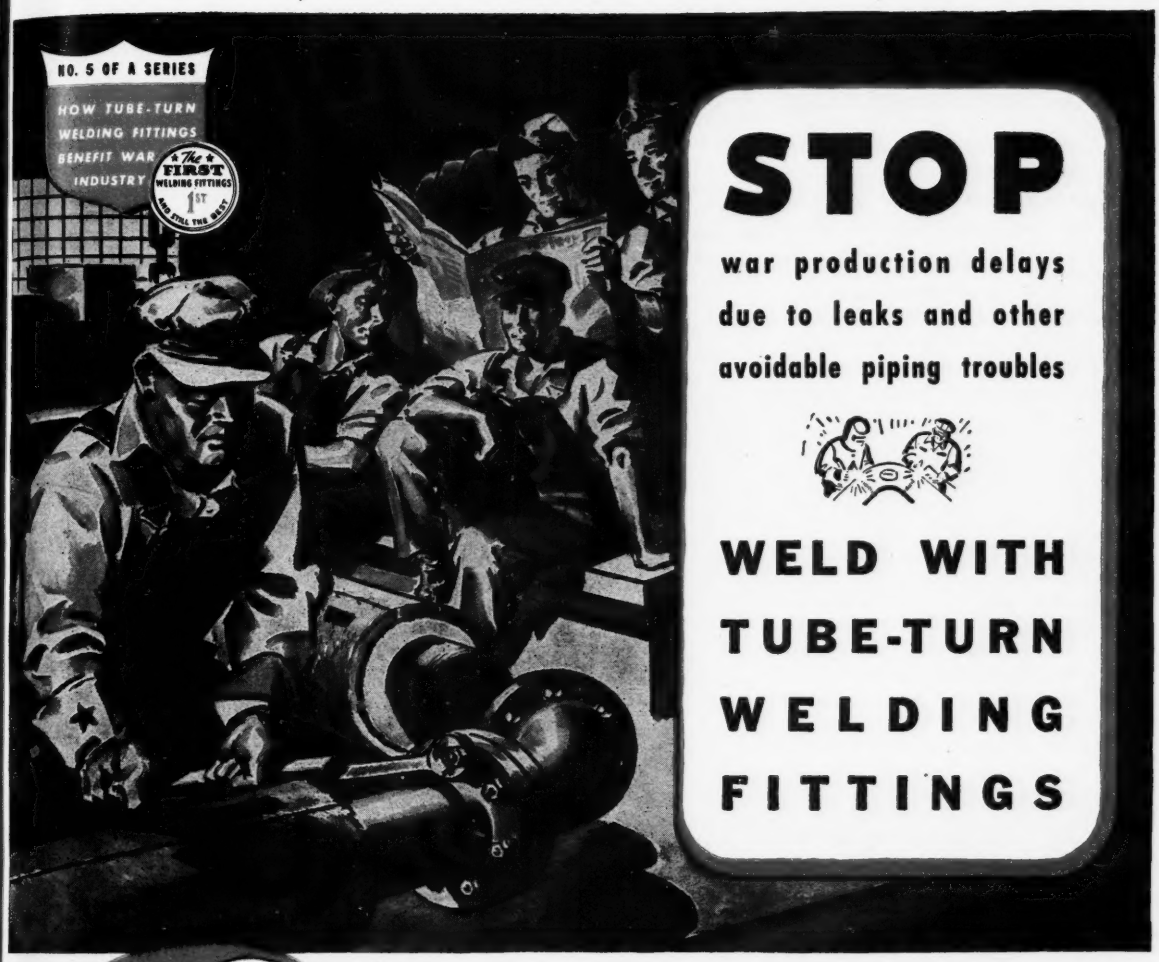
Corrosion as a result of dissolved oxygen has been overcome by mechanical or chemical means but the formation of iron oxide as a consequence of the evaporative process still occurs. Metallic copper and at times zinc oxide in boiler deposits result from reactions in pre-boiler equipment and must be attacked there, otherwise they will settle out in the boiler wherever decreased circulation allows.

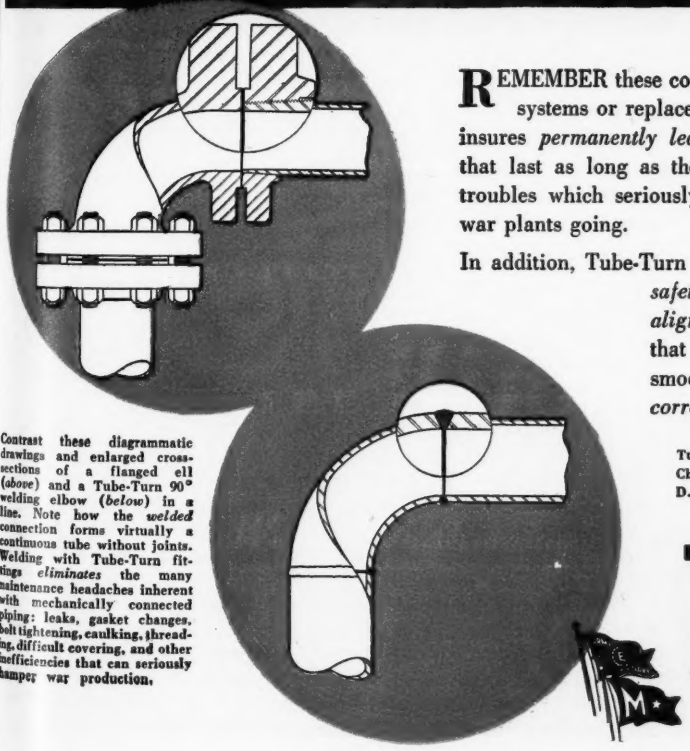
In a steam blanketed tube, sudden variations in temperature produced by slugs of water striking the steam blanketed area are produced, stressing the metal severely. Carryover of boiler water solids to superheaters and turbines is another feature of high pressure operation. Recent developments indicate that vaporization of boiler water solids may cause depositions and this is a problem for the chemist.

Education in Wartime

In his paper Practical Education in Wartime, at the opening session, Philip W. Swain, editor of Power, considered two basic questions: 1. What is worth learning? 2. What is the best way to learn it? Pointing out that wartime education becomes intensely

(*Continued on Page* 112)


NO. 5 OF A SERIES
HOW TUBE-TURN WELDING FITTINGS BENEFIT WAR INDUSTRY
The FIRST WELDING FITTINGS AND STILL THE BEST
STOP
war production delays due to leaks and other avoidable piping troubles
WELD WITH TUBE-TURN WELDING FITTINGS



Contrast these diagrammatic drawings and enlarged cross-sections of a flanged ell (*above*) and a Tube-Turn 90° welding elbow (*below*) in a line. Note how the *welded* connection forms virtually a continuous tube without joints. Welding with Tube-Turn fittings *eliminates* the many maintenance headaches inherent with mechanically connected piping: leaks, gasket changes, bolt tightening, caulking, threading, difficult covering, and other inefficiencies that can seriously hamper war production.

REMEMBER these common-sense facts before you install new piping systems or replace old sections: welding with Tube-Turn fittings insures *permanently leakproof, trouble-free joints* and better fittings that last as long as the pipe itself. You banish many maintenance troubles which seriously interrupt the vital *piping arteries* that keep war plants going.

In addition, Tube-Turn welding fittings give you *greater strength and safety;* uniform wall thickness, for *easier, faster alignment and welding;* compact piping layouts that *save space, weight and installation time;* smooth inner walls that mean far *better flow, less corrosion* and *greater piping efficiency.*

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(*Continued from Page* 110)

practical and narrow, he showed that many of the "practical" subjects have high cultural value. As to method, he pleaded for abolition of the lecture system and for more doing.

Heat and Power in Army Camps

The Fuel and Heating Program at Army Cantonments was discussed by Lt.-Col. Louis C. McCabe, Chief of the Heating & Refrigeration Section of the Repairs and Utilities Branch, Construction Div. Office, Chief of Engineers.

The Army is one of the largest consumers of fuel, planning to use between 8,000,000 and 9,000,000 t. of coal in 1944. Of the total fuel requirements 77 per cent is coal, 18 per cent natural gas, 5 per cent oil and miscellaneous fuels. As a result of recent studies, the degree day method is used for space heating and a constant designated as pounds of standard fuel per thousand feet of floor area per degree day is used for determining fuel allotments for various types of buildings.

Draft gages on all boilers over 100 hp., steam flow meters and CO_2 recorders on boilers of over 300 hp. and automatic draft controls for boilers over 150 hp. aid greatly in maintaining efficiency with inexperienced personnel.

A continuous program of education in combustion is carried on because of constantly shifting personnel, shortage of man power and the size of the program.

Power and Lighting Problems at Army Cantonments were described by J. A. Heffernan, Chief, Electrical Utilities Unit, Office Chief of Engineers. The Army maintains 18,000 mi. of line, 16,000 of which are overhead. Consumption of over 2,750,000,000 kw-hr., of which only a small portion is generated by the Army, will develop a maximum demand of 550,000 kw. Interior lighting represents over 50 per cent of the total connected load at the average cantonment, connected power load over 25 per cent, cooking 15 per cent, street and protective lighting about 2 per cent.

Trained linemen and electricians are scarce, so reference libraries, training courses and conferences, co-operation with the utility industry in the Utility Wartime Aid Program and pooling of equipment are carried out.

Logistics

The fate of our civilization depends on our ability to mobilize, stimulate and effectively use all our knowledge to get the right number of the right things and the right people to the right places at the right time. This is logistics, discussed in a very forceful and inspiring address by Col. James L. Walsh, Chairman, War Production Committee, A.S.M.E., at the All Engineers Dinner on the evening of April 8. James D. Cunningham, president of Republic Flow Meters Co., was toastmaster at this dinner.

At the first conference luncheon, on Thursday noon, April 8, a joint luncheon with the A.S.M.E., presided over by J. R. Michel, a very interesting talk on Company Organization of Manpower was delivered by E. H. van Delden of Allis-Chalmers Mfg. Co.

Another extremely interesting and valuable paper, was that on Possibilities and Limitations of Small Hand-Fired Furnaces by Prof. J. R. Fellows of the University of Illinois. This paper described a new type of down-draft coking furnace for domestic heating installations, developed at the university, for burning bituminous coal. This is designed to produce good combustion, with no smoke, a minimum of attention, ease of control, low draft, and a calculated average efficiency of 84.1 per cent. Since every engineer present was interested in his own domestic heating problems, the paper was received with great interest.

Protection of Power Plants In War

That the public utility industry must give its attention to safety in order to maintain its steady flow of energy that is making our war production possible was emphasized by Major Ralph W. Applegate, Chief, Industrial Safety Branch, 6th Service Command. He explained how the safety organizations of the Army itself co-operates with the utilities.

To protect our industrial power supply from enemy attack, special measures must be taken. Many of these were discussed by Lt.-Col. Arthur G. Coulson, O.D., Chief, Continuous Security Branch, 6th Service Command, in his paper Wartime Protection of the Power Plant. Proper guarding and protection against fire are essential, he said. For example, manhole covers on water ducts leading to pumps should be fastened so that a floating bomb cannot be introduced. Coal piles should be arranged for isolating portions of them if they catch fire; oil tanks should be dyked and drainage pro-oil or gas-fired furnaces, to prevent explosions, is necessary. Coal conveyors should be kept free of coal dust to prevent fire and proper extinguishing equipment provided.

The easiest point for an enemy to strike is the power lines, yet these are the easiest to repair, especially if spare tower parts or ready-cut wood frames and the like are kept ready.

Engineering Economics of Product Design was a paper by Ronald B. Smith of Elliott Co. For power equipment, he said, where operating costs outweigh first cost and production and market do not justify mass manufacture, research directed at operation may yield a realistic gain. For example, a modern 5000-kw. turbine at an average load factor of 45 per cent may have a heat rate of 17,100 B.t.u. per kw-hr. The first cost of the turbine alone, fully equipped and ready to drive the alternator, will be about $72,500. With coal at $4.50 a ton, the first year's fuel cost will exceed $55,000 or more than 75 per cent of the purchase price of the prime mover. Under these circumstances, a 15 per cent improvement in the prime mover efficiency could justify an increase of 100 per cent in the first cost of the machine; or from another viewpoint, a 15 per cent failure to meet performance would be sufficient grounds to reject the machine as a gift. It is improbable that a 15 per cent improvement in 5000-kw. machines will be possible, but an incentive of $5000 for each per cent per machine indicates that development will not remain static.

Applying the same reasoning to single-stage centrifugal blowers, which are important in aviation use and in many war-time industrial applications, the speaker showed that a 7 per cent improvement in efficiency could be evaluated at the full purchase price of the equipment.

The speaker then gave a mathematical analysis of the factors in blower design and compared modern blower and centrifugal pump efficiencies.

At the joint luncheon with the A.I.E.E. on Friday, April 9, F. H. Hollister, chief electrical engineer of Sargent & Lundy, gave a paper on Conservation in Design of Power Stations, from which extensive extracts will be published in the next issue.

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5-BA-1

Boiler Maintenance in Wartime*

Here are methods the power plant engineer can use to get more steam with less maintenance. Faced with labor, material and equipment shortages, he must often operate 24 hr. a day to carry the war load, getting far more out of existing equipment than anticipated when it was installed. With a good maintenance program, however, for which management must allow him some time, war production need not suffer. Here are details of maintenance he should carry out on furnaces, firing equipment, boilers, economizers, air heaters, superheaters, fans, pulverizers—how to find out what maintenance they need, how to do it—and the reasons why.

By A. C. Foster

Manager, Service Dept., Foster Wheeler Corp.

INSISTENCE that production be sustained at all costs is risky business when the power plant has reached the point where patches are being patched. Take stock, determine what is necessary, how long it will take to complete an inspection and maintenance program, arrange for it and do it. Nine times out of ten, it will be found that production will not suffer at all because the higher output will be possible with ease, once the equipment has been put back in first class condition.

No piece of equipment in the power plant is so dependent upon the proper functioning of its individual components as is the steam generating unit. Consider excessive furnace maintenance: Neglecting the possibility that inferior coal is the cause, it may result from too high a furnace temperature which, in turn, is due to operating with too low excess air which, in turn, may be due to lack of induced draft fan capacity caused by excessive wear, reduction in efficiency, and loss of capacity due to excessive repairs to blades or, perhaps, it is due to lack of forced draft fan capacity resulting from excessive air heater leakage.

It may be caused by the equipment being operated at outputs far beyond what can be considered safe. This may be especially true of plants in which the designer installed oversize fans so that, if slagging occurred at normal maximum load, the fans would be large enough to overcome the added draft loss. Today, the fact that the fans are oversize may be reason enough for the operators to increase the continuous output of the unit to the limit of the fans, with the result that maintenance of furnace and firing equipment increases out of all proportion to the increased output obtained. On the other hand, excessive furnace maintenance may result from deficiencies in the firing equipment that have come about just through a normal gradual deterioration.

The first step in organizing a program of preventive maintenance is for those responsible for operation and maintenance to get together and map out a program designed to discover where the bottlenecks are that reduce potential capacity or deficiency, and increase maintenance. The best way I know to start is to make a complete performance test at maximum output. A study of the data obtained should then indicate where the major returns may be expected from efforts expended in correcting these deficiencies. The manufacturer of the equipment may be called upon to advise in the method of making the test and to cooperate in the analysis of the data obtained.

Furnace Maintenance

Generally, little furnace maintenance is necessary in the completely water or steam cooled furnace. However, on those furnaces containing appreciable amounts of exposed refractory, furnace maintenance may be one of the major repairs. The impingement of flame on furnace walls, whether they be refractory or water-cooled, is something to be avoided. Even furnace tubes of units having the most excellent condensate feed can fail due to internal deposits of scale and organic matter that form at regions subjected to flame impingement.

Coal distribution may be checked (1) visually; (2) by carefully timed sampling in the coal conduits; and (3) by analyzing the flue gas at the boiler entrance, taking samples every foot across the width of the boiler through a water-cooled sampling tube, to determine the CO_2 distribution. Poor fuel distribution may result in localized slagging and increased maintenance, may also limit the output.

Instruments which have been adjusted to indicate CO_2 at the boiler outlet may, because of serious air infiltration through the setting, result in operation with entirely too high a CO_2 in the furnace. This will be shown up by the flue gas traverse at the boiler entrance.

The furnace setting should be carefully examined, particularly the ashpit and seals between the ashpit and furnace, for air leakage. Poor combustion may be blamed on the burners, when it is actually due to their getting an inadequate supply of air with the fuel because of high furnace leakage.

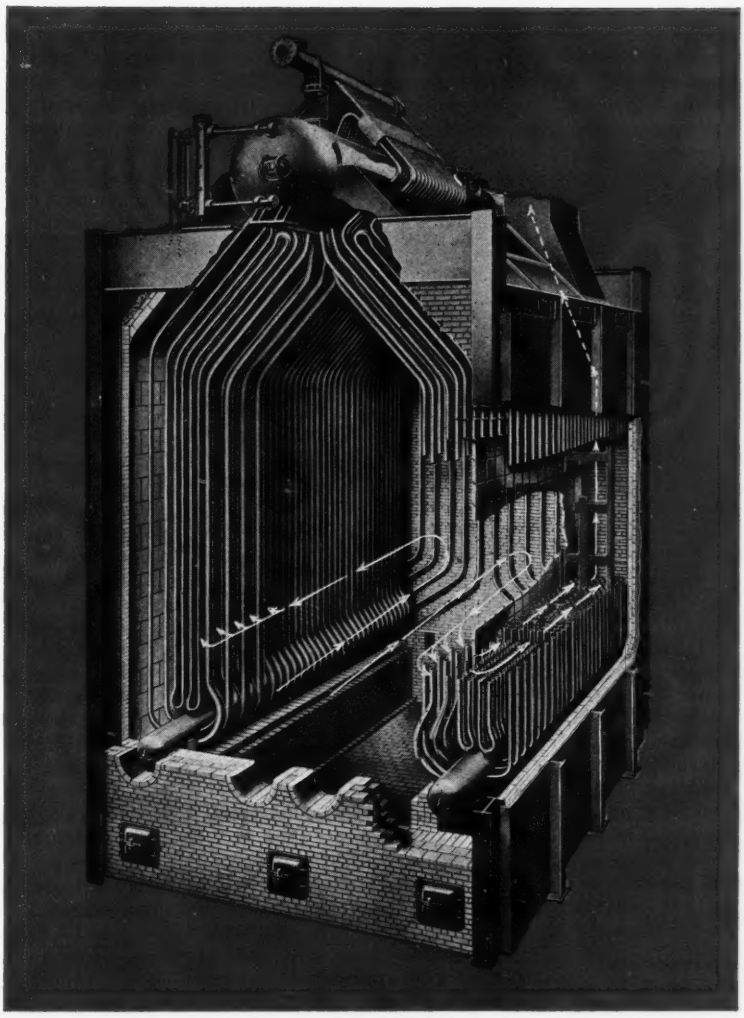
Furthermore, air entering the furnace as leakage means that that much less air passes through the air heater, more coal has to be burned, pulverizing equipment must be operated at higher output and its maintenance, therefore, increased.

Furnace repairs cannot be hurried, particularly where appreciable refractory replacement is involved. A study should be made of the materials available for repairs and the directions applying to their proper use fully understood. Time must be allowed for refractory materials to set. One of the chief reasons why many furnace refractory repairs do not last is because the unit was returned to service before the material had set properly.

Boiler Maintenance

To get an estimate of the boiler

*Paper presented at Midwest Power Conference, Chicago, Ill., April 9, 1943.



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maintenance necessary to improve performance, average boiler exit gas temperature should be measured by a careful traverse with a thermocouple. This should then be compared with that expected by the designer. High exit gas temperature requires that more fuel be burned for a given output. Reducing the exit gas temperature will permit operation at increased output. A careful temperature and gas analysis traverse will show up leaky baffles, setting leaks, poor burner operation and fouled surfaces.

Tubes containing internal scale should be turbined. If scale is serious, the services of a competent feedwater specialist should be retained to recommend means for scale elimination. External scale and soot indicates repairs should be made to soot blowers, or perhaps additional blowers installed, or the soot blower operating pressure increased.

High furnace maintenance, caused by lack of fan capacity, may be materially cut down by reducing draft loss. Particularly in older designs, restrictions may be removed without materially affecting the efficiency, enabling operation at higher loads without excessive furnace temperature. On the other hand, baffling may be opened up at the expense of a slight reduction in efficiency but with a material saving in maintenance.

Baffle Repair Very Important

Of all the boiler repairs likely to be neglected, repairs to baffles probably rank at the head of the list. The all-round improvement to be obtained from maintaining baffles in good repair cannot be over-estimated. Leaky baffles increase fuel consumption and reduce maximum output. If high gas velocities occur at the leaks, the flyash passing through with the gas may cut through tubes, causing real trouble.

Drop in CO_2 between the boiler entrance and exit should be measured to ascertain the amount of air infiltration. Generally, it is advisable to seal the setting as well as possible and check the CO_2 drop again and to keep testing and sealing until the drop in the CO_2 is not more than one-half of one per cent.

Tube repairs for boiler, waterwalls, superheater and economizer have become simplified through the use of welding. It is no longer necessary to install an entirely new tube or element. The defective section may be cut out, the ends machined for the insertion of chill rings and a new section welded in. Such repairs should be made only with the permission of the State or Insurance Company concerned, and in accordance with the existing Code, with properly qualified welders.

Check Steam Drum Internals

At all inspections, the steam drum internals should be checked carefully, also the continuous blow-off piping, to make sure that it is located below the normal water line, and the chemical feed lines to make sure they are free and clear, since they plug easily. Where steam washers and driers are installed, care should be taken to see that they are tight and that it is not possible for dirty steam or boiler water to bypass the washer or drier directly into the steam outlet.

It may be found that alloy baffle supports, spacers, and the like can no longer be supplied of the original alloy material. In such cases, replacement may, generally, be made with a good grade of cast iron.

Superheater Internal Surfaces

Maintenance of superheaters may amount to a considerable item, particularly on older installations being operated at higher than usual loads. First, determine the final steam temperature and the pressure drop and compare the results with the guarantee. The pressure drop will indicate whether any appreciable internal fouling, due to carryover of boiler water solids, may have occurred. Internal fouling may bring about failures due to overheating.

When the deposits are not soluble in water, good results have been obtained by boiling-out the superheater with a five per cent solution of lactic acid, made by dissolving forty-four per cent grade lactic acid in water. The elements are filled with the solution and the unit fired at a moderate rate to maintain a temperature in the superheater of about 200 deg. F. for ten or twelve hours. At the end of this time each element should be flushed out individually with hot, clean water for ten or fifteen minutes.

Superheater Slagging

Overheating and failure of superheater tubes may be caused by slagging of the superheater. Such slagging may indicate the necessity for more effective soot blowing, more frequent use of soot blowers, the necessity for hand-lancing, etc.

In some cases, particularly superheaters operating at temperatures above 850 deg. F., the external surface will be found to be covered with an adherent deposit that appears to be fused onto the tube. Such coatings cannot be satisfactorily removed even with high speed revolving steel brushes. Sandblasting appears to be the only method that will return the elements to their original condition.

Investigate Superheater Circulation

More superheaters are damaged while the unit is being placed in operation, when little or no steam is flowing through them, than at any other time. During the warming up of a cold boiler and superheater, the heat must be uniformly distributed over the superheater surface. This is especially important with superheaters of the non-drainable type, in which it is necessary to evaporate completely the water that has collected in them by condensation, during a shutdown, from all of the element legs before steam flow through the elements can be established.

The way to prevent such damage is to limit the firing rate, while bringing the boiler up to pressure, so that the gas temperature entering the superheater does not exceed 1,000 deg. F.

In the case of large superheaters, it is recommended that this gas temperature be checked with thermocouples, and a standard "starting-up" firing rate or intermittent firing procedure that will assure no overheating be developed. There is also likelihood of damage through overheating during low loads and when on banked fire. A safe procedure is to open the drain valves fully when the boiler is first taken off the line, and close them when the furnace becomes dark.

Excessive maintenance may result from the presence of water in headers. Superheated steam flowing through may heat a portion of the header while the balance remains relatively cool, causing temporary distortion. This is a common condition in banked boilers, especially where superheater headers are located outside the boiler setting. It will be found that this condition starts most superheater handhole plug leakage, which, if allowed to continue, cuts seats and results in extensive repairs. The proper preventive is to drain

(*Continued on Page* 132)

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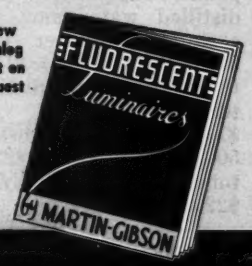

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Pure Water Without Heat

Costs of purifying water by stills and by regenerative exchange filters using resins in a food and beverage plant are compared, also chemical principles involved in process used for water purification by synthetic ion exchange resins are outlined

By ANTHONY A. FETTE

IN A CERTAIN plant which the writer supervises a considerable quantity of distilled water is used for process. For a number of years the distilled water was produced in the conventional manner by condensing steam into distilled water. During the past year there has come to our notice a method of producing this pure water in a method similar to the zeolite softener, with the exception that the unit has two exchange elements to the zeolite's one unit. A small unit was given a trial and proved quite satisfactory, after which a larger unit was installed and at present a still larger unit is under consideration.

Formerly three shifts were employed, a man on each shift to operate the water stills, which practice has been discontinued. The present unit produces 50,000 gal. of water between regenerations. The unit was guaranteed for an output per hour of 400 gal. and has had an output of 625 gal. per hr., on some occasions.

In the following is given a comparison of costs previous to and since the installation of the new system, and the savings effected.

Labor Cost—Three 8-hr. shifts at $0.93 per hour 7 days per week and 50 weeks per year = $7,812.00 per year for distilled water.

Average yearly run, 4,500,000 gal. or 37,485,000 lb. of water.

Steam Cost — Considering one pound of steam per pound of distilled water and a steam cost of $0.40 per 1000 lb., 37,485,000 × 0.40 = $14,994.00, the steam cost for distilled water.

$14,994.00, steam cost, + $7,500.00, labor cost = $22,494.00, total cost of distilled water.

$$\frac{\$22,494.00}{4,500} = \$4.998 +$$

or approximately $5.00 per 1000 gal. cost of distilled water, or $0.50 per 100 gal.

With the new system the men formerly employed on the steam still were employed at other work and the men in charge of the boiler room water softener plant now attend the new units and the cost of the distilled water with the new system results as follows:

Muriatic acid per charge ...$8.00
Soda ash per charge ..... .18

Total cost per regeneration..$8.18 (per 50,000 gal.)

This is 16 1/3 ct. per 1000 gal., or a saving of $4.8364 per 1000 gal., or $21,763.80 per year. The installation cost was around $2500.

Regeneration time:

Back wash both acid and hydroxide tank—30 min. each.

Inject 10 gal. pure muriatic acid in acid tank — 30 min., cost $8.00

Inject 18 lb. of soda ash in hydroxide tank—45 min., cost $0.18

Rinse both tanks with fresh water, approximately 90 min. (Rinse is continued until soluble solids lower to 1.5 p.p.m., approximately 30 min.)

Total time approximately 4 hr.

Use of Condensate

In this plant condensate returns were previously used, also since the use of the new system the same condensate is used for distilled water.

The condensate, which was over 200 deg. F. in temperature, was used in the steam stills and vaporized, which vapor was then passed through a condenser. This system prevented the formation of scale in the evaporators and stills. The thought may prompt itself, why not use the steam from the boilers direct, and condense it, and the answer is that it is a food and beverage plant and the feedwater may carry over and contamination may result, hence the best water available is used for reboiling and distilling.

With the new system the returns are cooled, as the water to be treated must be less than 95 deg. F. in temperature. The solids in the condensate averaged approximately 45 p.p.m. when the unit produced 50,000 gal. of water between regenerations. The exchange resins were determined to have a bed capacity of 100,000 gal. of de-ionized water between regeneration cycles, based on the total dissolved solid content in the condensate of 15 p.p.m. We noticed a fluctuation in our condensate solids during the period when the equipment first went into service. It was interesting to note that as the condensate solids increased, bed capacity decreased proportionately to the rise in solids. The total dissolved solids were found to be 45 p.p.m. during one complete cycle, and the resins produced 50,000 gal. during this period.

By some changes we have selected and isolated the best of the returns and now secure condensate which varies between 5 and 10 p.p.m.

The water to be treated must be cool and for test purposes we allowed it to rise in temperature within safe limits and the following are the results obtained:

Degrees F.	P.P.M. by Solu-Bridge
75.0	.35
80.5	.45
84.2	.50
93.0	.70
95.0	.98
102.0	1.20
107.0	1.50
112.0	1.90
114.0	2.00
115.0	2.20
123.0	2.80
132.0	4.85

These results demonstrated to us the advisability of using the water as cool as possible in order to secure the best results.

Base Exchange Principle Employed

The material through which the water passes consists of synthetic resins, which operate on a base exchange principle, similar to zeolite softeners. These resins, however, have the property not only of removing calcium and magnesium ions without the introduction of a corresponding sodium ion, but also remove the sulphate and chloride ions. A water approaching distilled water is obtained by this method. The resins used are of several types, but in

(*Continued on Page* 138)

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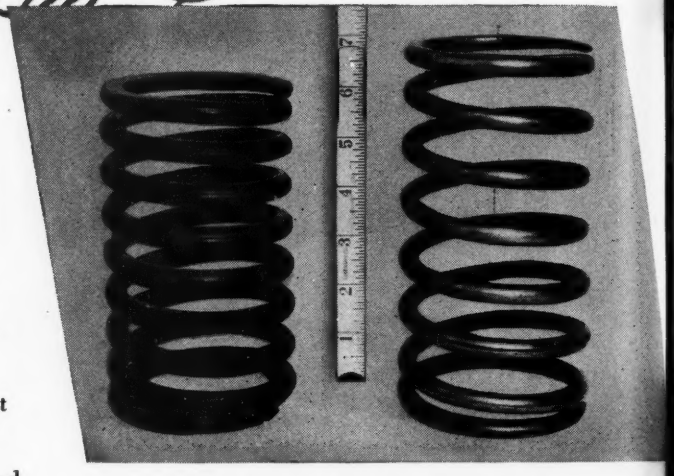

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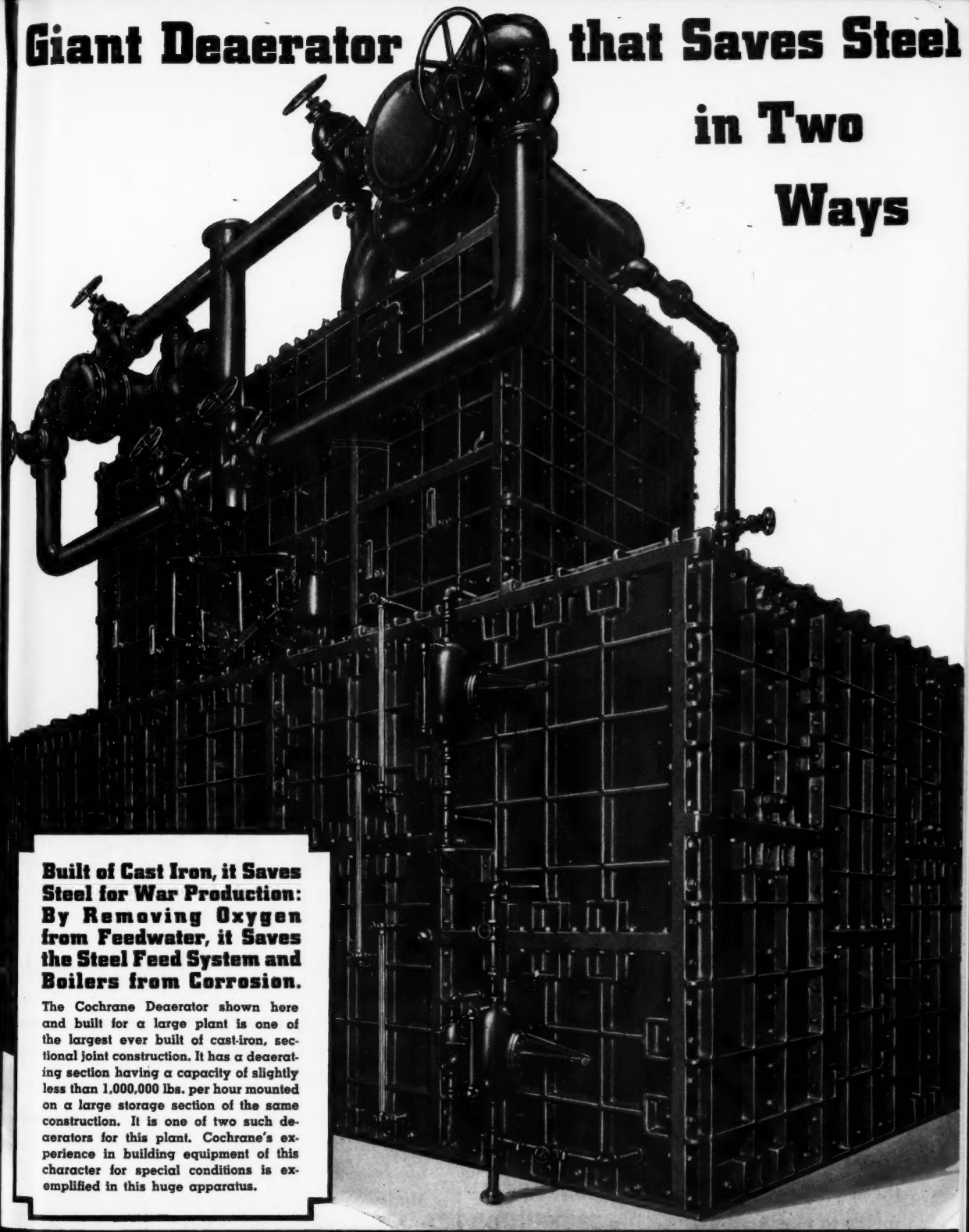

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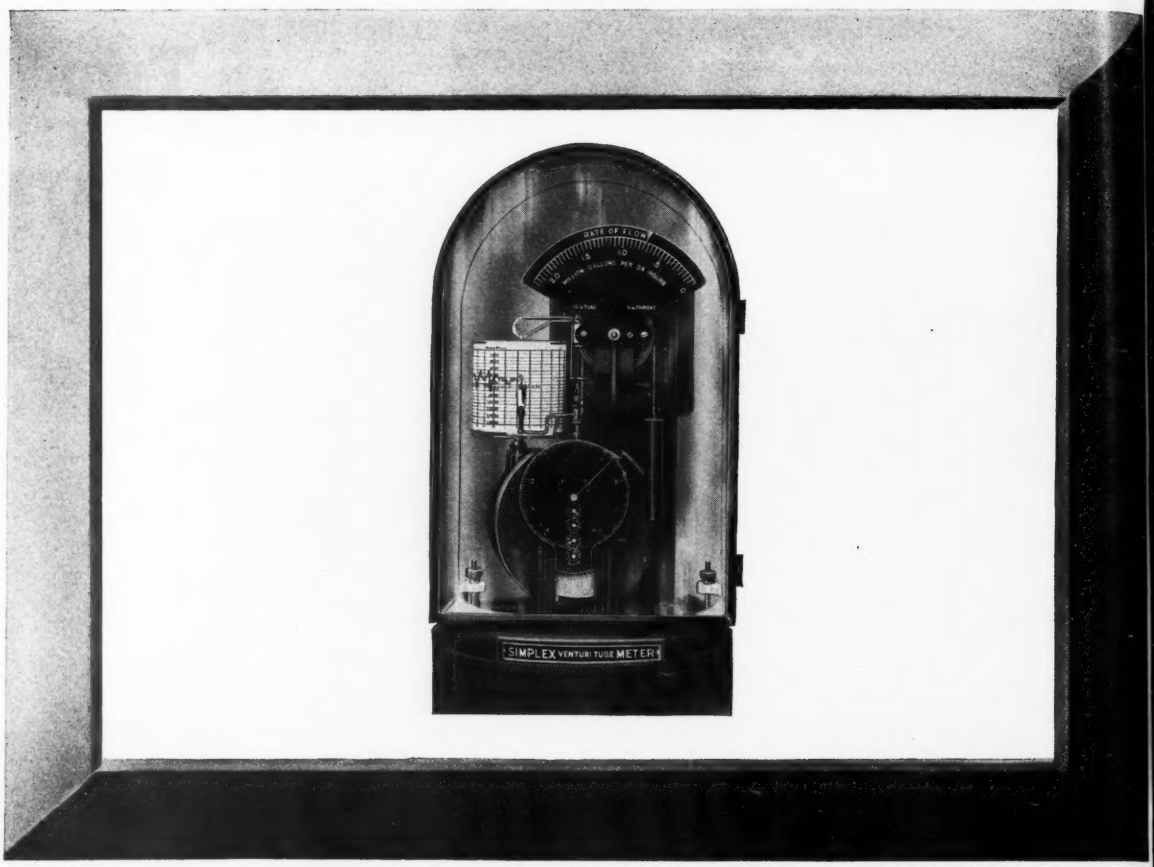

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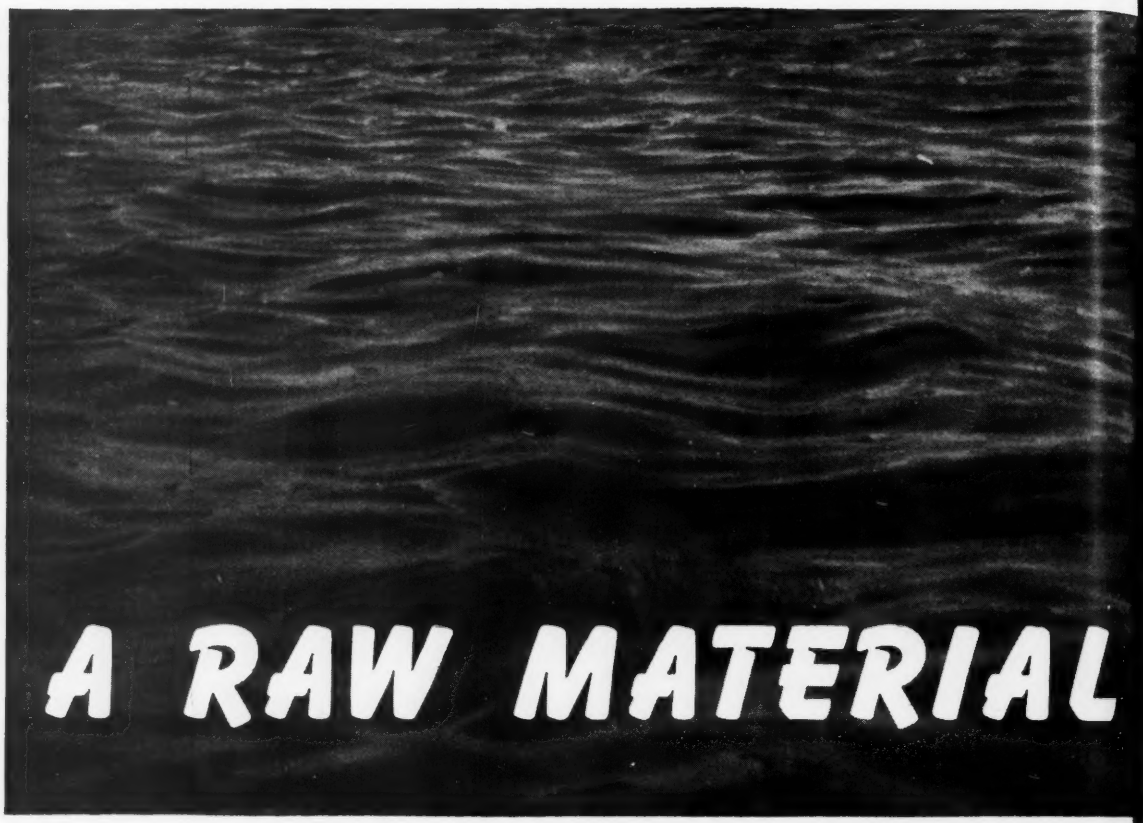

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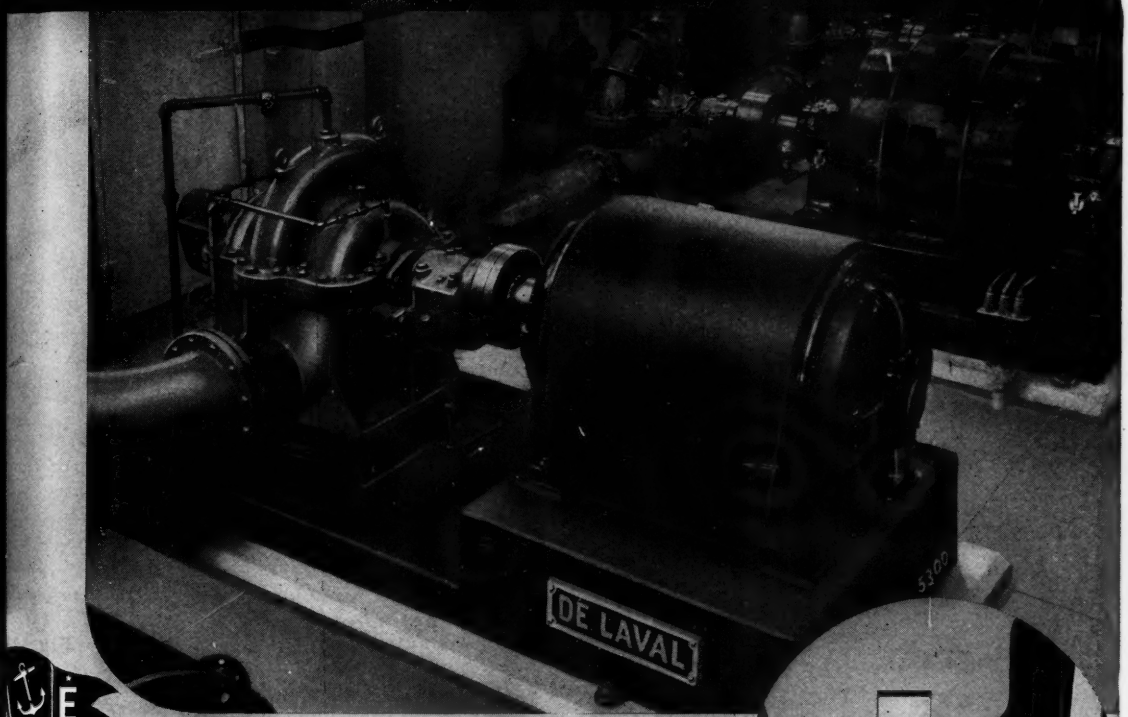
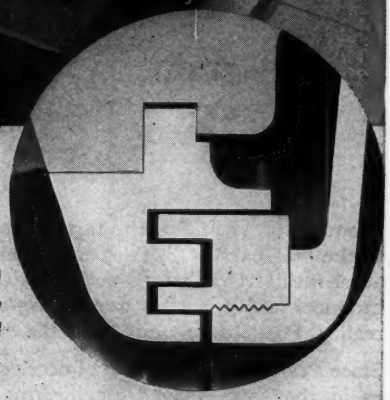
More than 2½% over guarantee





Cross section of De Laval double labyrinth wearing rings; one ring is held by the casing, while the other is screwed onto the impeller.

***The* DE LAVAL MOTOR DRIVEN PUMP** in the foreground was supplied to a Canadian public utility under a guarantee to deliver 4000 Imperial gallons per minute against a total head of 217 ft. with a wire-to-water efficiency of 78 per cent.

In the official acceptance test by the customer's consulting engineer, this was exceeded by more than 2½ per cent.

The Utility has now ordered for standby service a similar De Laval pump of 5000 Imperial gallons capacity against the same head and driven by a gasoline engine.

The sustained high efficiency of De Laval pumps is made possible by correct hydraulic design and, in large part, by the DE LAVAL LABYRINTH WEARING RINGS, without resort to the close clearances necessary with flat rings. These, and other parts subject to wear, are easily renewable, as they are made to limit gages to be interchangeable.

2538

DE LAVAL *Steam Turbine Co.*
TRENTON, N. J.

MANUFACTURERS OF TURBINES . . . STEAM, HYDRAULIC, PUMPS . . . CENTRIFUGAL, CLOGLESS, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, PROPELLER, PRIMING SYSTEMS; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS . . . WORM, HELICAL and FLEXIBLE COUPLINGS

POWELL has the valves YOU need!

Fig. 1460

Fig. 190

From 1846, when Powell started making valves, until the outbreak of the "Global War", the pace of industrial progress was constantly accelerating. One after another, with ever-increasing rapidity, new products and processes were being evolved. And as each became a reality, Powell was ready with the correct valves.

Since Pearl Harbor the rate of acceleration has reached a peak. And—as in the past—Powell Engineering has been meeting every challenge★. Let us help you with any valve problem you may have—Powell has the valve you need—or we'll design one for you.

★For the contribution we are making toward winning this War, we have been honored with the Army-Navy "E", the Maritime "M" and the Victory Fleet Flag.

Fig. 190—Iron Body Bronze Mount "Irenew" Globe Valve for 150 pou W. P. Screwed ends, union bonnet a regrindable, renewable hard bronze pl type seat and disc.

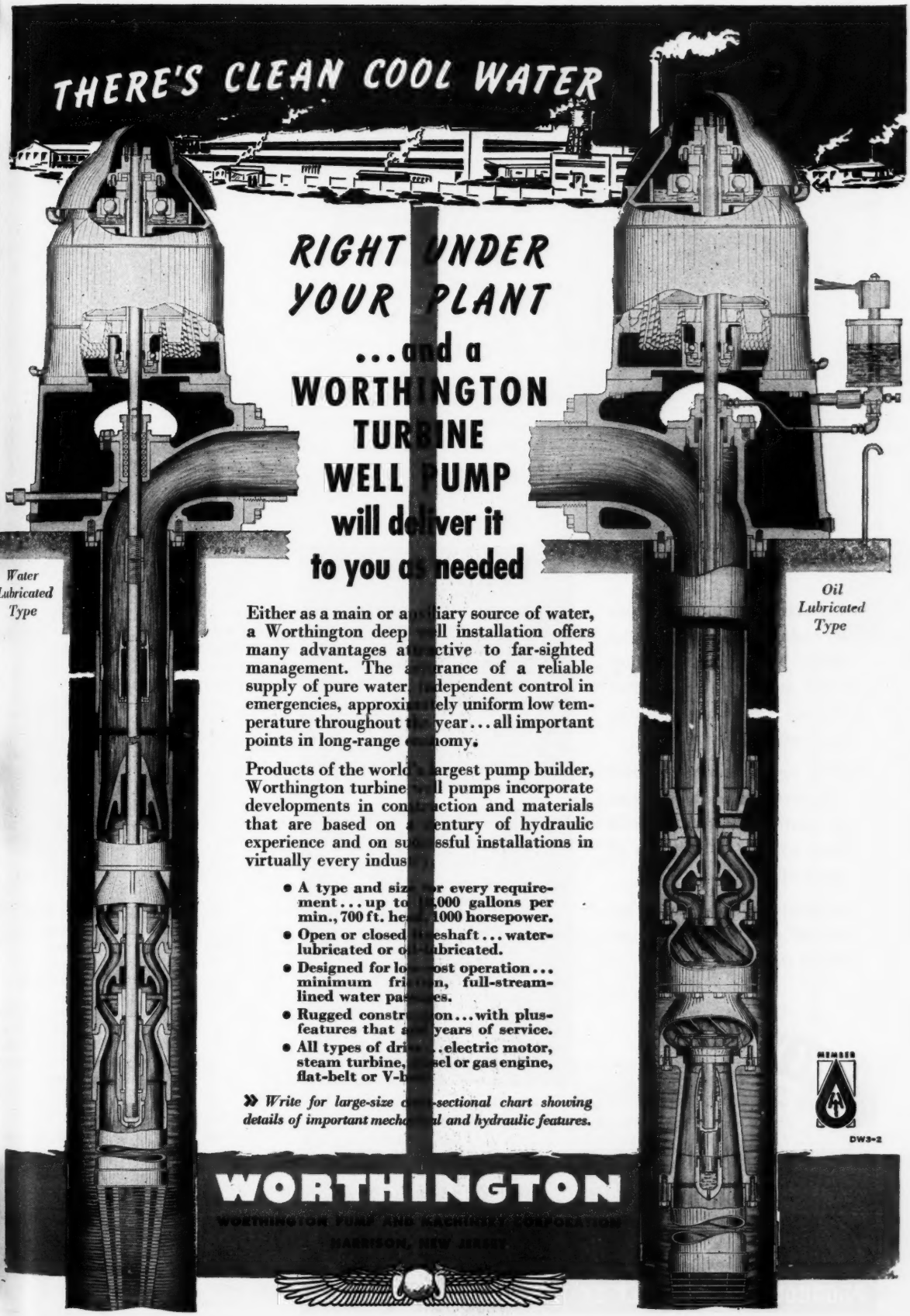
Fig. 1460—Iron Body Bronze Mount "Master Pilot" Gate Valve. Screwed en bronze rising stem, bolted flanged bon and taper wedge bronze solid disc. Si ¼" to 2" for 150 pounds W. P.; 2½" 4" for 125 pounds W. P. Also availab in All Iron—Fig. 1462.

The Wm. Powell Company

Dependable Valves Since 1846

Cincinnati, Ohio

POWELL VALVES



RIGHT UNDER YOUR PLANT

...and a WORTHINGTON TURBINE WELL PUMP will deliver it to you as needed

Water Lubricated Type

Oil Lubricated Type

Either as a main or auxiliary source of water, a Worthington deep well installation offers many advantages attractive to far-sighted management. The assurance of a reliable supply of pure water, independent control in emergencies, approximately uniform low temperature throughout the year... all important points in long-range economy.

Products of the world's largest pump builder, Worthington turbine well pumps incorporate developments in construction and materials that are based on a century of hydraulic experience and on successful installations in virtually every industry.

- A type and size for every requirement... up to 15,000 gallons per min., 700 ft. head, 1000 horsepower.
- Open or closed lineshaft... water-lubricated or oil-lubricated.
- Designed for low cost operation... minimum friction, full-streamlined water passages.
- Rugged construction... with plus-features that add years of service.
- All types of drive... electric motor, steam turbine, diesel or gas engine, flat-belt or V-belt.

» *Write for large-size cut-sectional chart showing details of important mechanical and hydraulic features.*

MEMBER

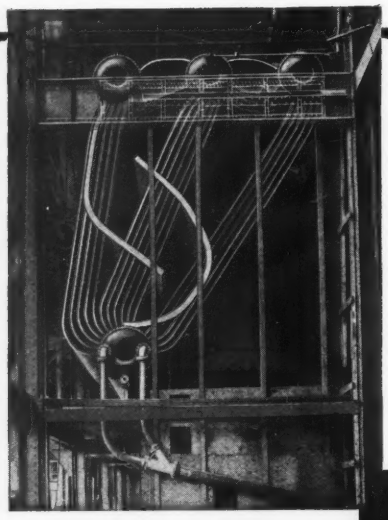
DW3-2

WORTHINGTON

WORTHINGTON PUMP AND MACHINERY CORPORATION
HARRISON, NEW JERSEY

MORE STEAM

QUICKLY EASILY

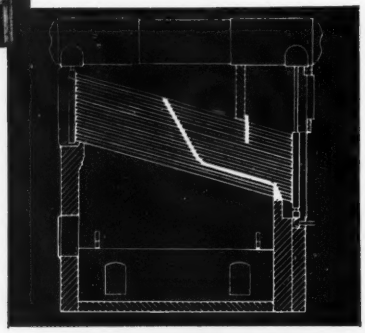


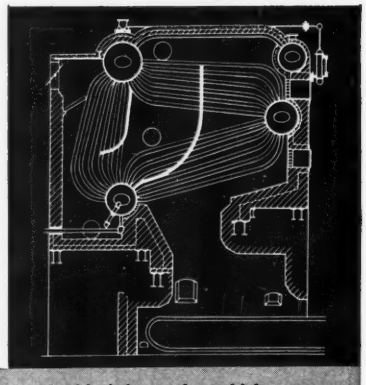
Steam output can be boosted quickly and easily by installing Enco baffles. These streamlined baffles prevent eddy currents and dead gas pockets. The cross-flow puts every square foot of heating surface to work.

Enco baffles reduce draft loss by doing away with bottlenecks in the passes. They save steam because soot blowers are more effective and used less often.

Each application is individually designed on the basis of 25 years experience with Enco baffling in all types of water-tube boilers.

Installations are made by skilled mechanics with selected materials.





FREE BOILER BAFFLES

● *A bulletin on boiler baffles gives valuable information which every engineer should have. Ask for bulletin BW 40. It's free.*

THE ENGINEER COMPANY

75 WEST STREET • NEW YORK, N. Y.

Enco Streamline Baffles

PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

Maintenance on Schedule

(*Continued from Page* 83)

the fact that no longer do we suffer the embarrassment of having an engine refuse to take full load because someone forgot to clean a fuel or air filter. Seldom do we get a call for help because the fuel transfer pump has lost its prime or the condensate return pump on the waste heat boilers has refused to function.

Probably most important of all, however, is the fact that the development of this system led us to check our crankshaft alignment and find that we had a deflection that greatly exceeded the 0.002 in. allowed for such an installation as ours.

Noticeable, too, has been the improvement in the overall cleanliness of the plant and especially the corners which are so easily missed when no one is made responsible for them.

In addition to the dividends which are already apparent there are those which will accrue and reflect, after a period of operation, in the form of reduced maintenance costs and repair bills, for after all, there is no SUCCESS formula that enjoys a better reputation than the one which says, "A Stitch in Time Saves Nine". It is one that always works.

NO. 119-124

American Air Filters, M-Q-1

1. Remove, clean and reinstall air filters.
2. Inspect air ducts and clean if necessary.
3. During frosty or sleet conditions inspect air duct each shift and see that door to air filter chamber is unlocked.
4. Sweep and clean air filter chamber.

NO. 305-310

Pickering Governor, M-Y-2

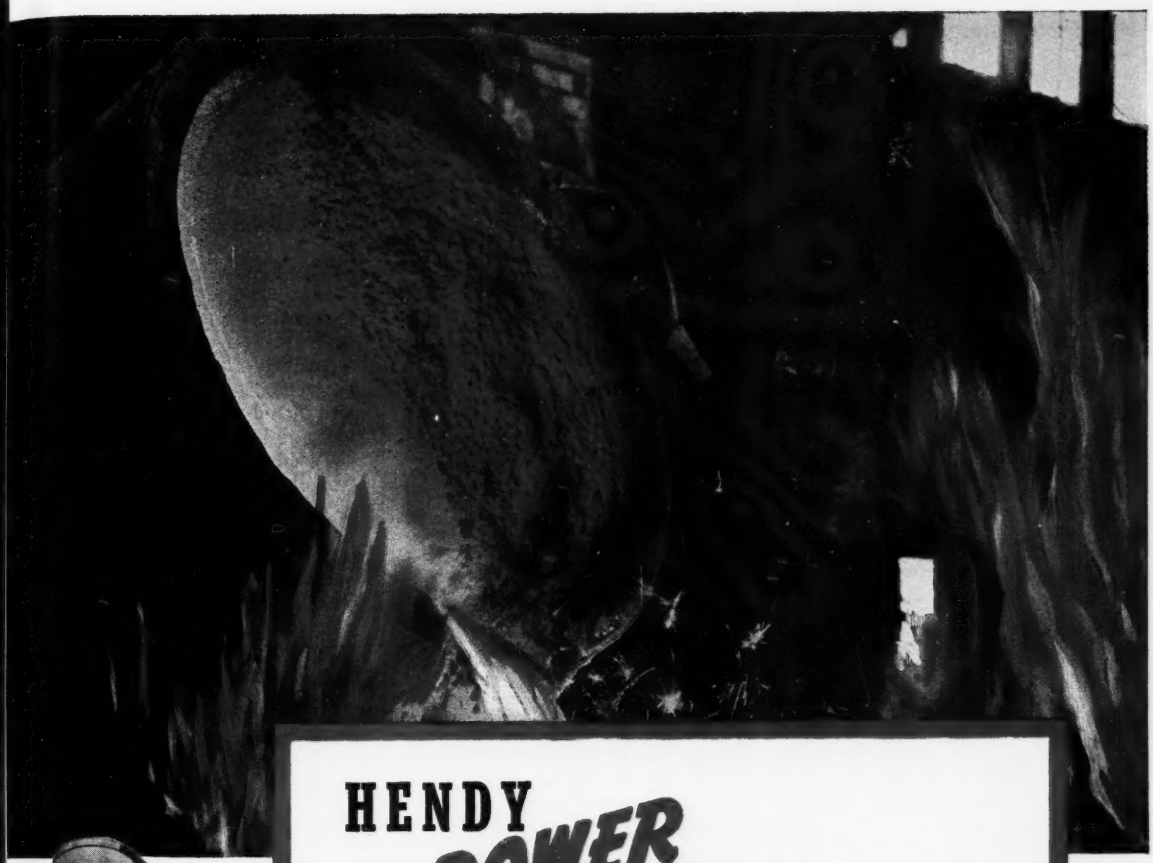
1. Remove drain plug and drain oil.
2. Flush with one quart of clean oil.
3. Refill with 3½ quarts of new oil.
4. Make NO internal adjustments on this equipment.

NOTE: Please refer to equipment file and the insert at the rear of your instruction manual for further information and instructions concerning the operation and care of this equipment.

NO. 6

Storage Battery Room, C-W-1

1. Check gravity on 5 or 10 cells and reset charger if found necessary.
2. Add distilled water to all cells that are low.
3. Clean window sill in battery room.
4. Wipe off all cells and battery stand using a clean dry rag.
5. Wipe off door and door frame using chamois skin.
6. Clean radiator and piping.
7. Pushmop floor.

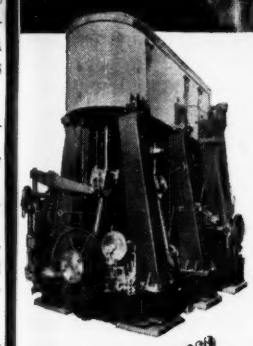


HENDY *POWER* for the Bridge-of-Ships

Spanning the oceans between production and fighting fronts are mighty flotillas of Liberty Ships . . . the floating bridges for men and munitions...now mass produced on a scale formerly believed impossible.

More than one-third of these vessels are powered with dependable Hendy steam engines . . . the same type of Hendy power plants that carried Yanks to France in 1918. Today, however, the Iron Men of Hendy turn out as many engines in 11 days as they built in two years of World War I.

If Joshua Hendy could see what has been accomplished since 1856 . . . how the Hendy nameplate has become the distinguishing mark of dependable POWER . . . if he could look over the shoulders of Hendy engineers and see their plans for the future . . . he would take justifiable pride in his vision that POWER wins wars and insures peace.



THE IRON MEN OF **HENDY**...

... now, for the first time in history, build marine steam engines by mass production, assembly line methods These engines stand two-and-one-half stories high and weigh 274,000 pounds.

JOSHUA HENDY IRON WORKS

HOME OFFICE

Sunnyvale, California

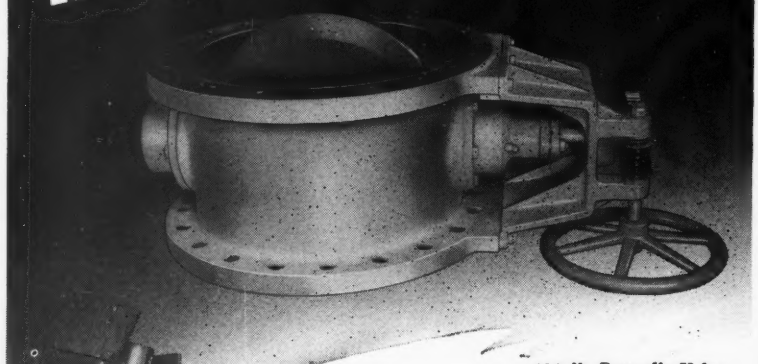
ESTABLISHED 1856

DIVISIONS: *Crocker-Wheeler Electric Manufacturing Company; Pomona Pump Company*

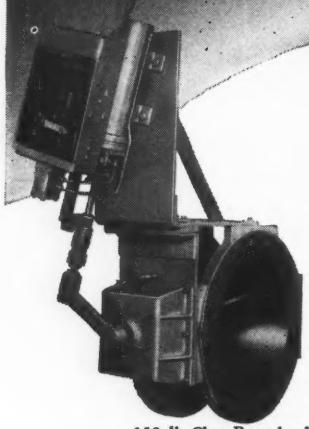
MANUFACTURING PLANTS: SUNNYVALE, LONG BEACH, POMONA AND TORRANCE, CALIFORNIA; AMPERE, NEW JERSEY; ST. LOUIS, MISSOURI

BRANCH OFFICES: NEW YORK, WASHINGTON, PHILADELPHIA, PITTSBURGH, CHICAGO, ST. LOUIS, SAN FRANCISCO, LOS ANGELES

Service Duration Tripled with R-S BUTTERFLY VALVES



125 lb. Butterfly Valve with hand wheel control, American Standard flanges.



150 lb. Class B steel valve with automatic controller.

15 to 900 psi

THE CASE HISTORY of a 6-inch, 125 lb. R-S Butterfly Valve illustrates the advantages and increased service to be obtained from this type valve. It was installed in a line leading to a condenser and used for shut-off under 70 lbs. pressure.

Previous installations of conventional type valves did not hold up and had to be replaced *every six to eight months* as the abrasive action of the fluid in the form of a high pressure "jet" wore a hole through the casing. When an R-S Butterfly Valve with "A" Metal was installed, the length of service was tripled.

Here is concrete evidence that even abrasive materials "fan out" into a crescent-shaped spray when the Butterfly Vane approaches a closed position. This fact, coupled with the use of "A" Metal in an R-S Butterfly Valve, produces outstanding results where hard wear and severe stresses are encountered.

The Butterfly Vane is not a "flopper." It is beveled and wedges against the valve body when closed. Compare—results prove the superior efficiency of this type valve under high or low pressures and temperatures.

Your R-S Distributor will gladly furnish detailed information.

VALVE DIVISION
R-S PRODUCTS CORPORATION
4535 Germantown Ave. Philadelphia, Penna.

R-S Streamlined BUTTERFLY VALVES

Boiler Maintenance in Wartime

(*Continued from Page* 116)

the water from the superheater before firing and during banked periods.

Economizer Maintenance

Economizer maintenance usually consists of cleaning the internal and external surfaces and reducing air leakage to a minimum. Inspection will indicate whether such cleaning is necessary and measurement of the drop in CO_2 between the economizer gas inlet and outlet will tell whether the air leakage is serious. The nearer the induced draft fan or stack is approached, the greater the necessity for sealing leaks.

On economizers having low inlet water temperature, that is, below 210 deg. F., oxygen corrosion may be the cause of considerable maintenance. The lower the temperature, the higher may be the oxygen content of the feedwater. In no case should the temperature fall below 180 deg. F.; preferably, it should be 210 deg. F. or higher.

External corrosion and fouling are generally caused by operating with too low tube metal temperature. When this temperature falls below the dewpoint of the gases, corrosive deposits are formed. The controlling factors in the formation of these deposits are the temperature of the incoming feedwater, the excess air and the percentage of sulphur in the fuel being burned.

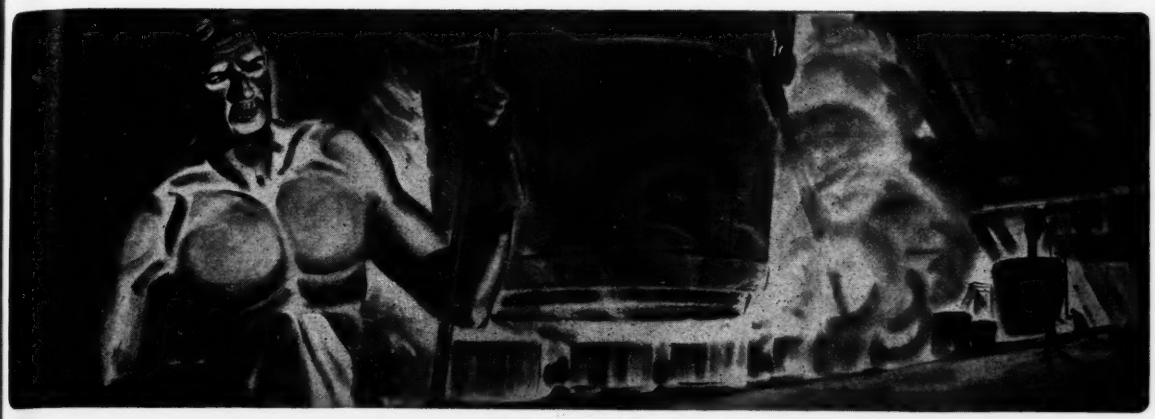
External deposits of this type may be removed by spraying them thoroughly with water at a temperature of 150 to 180 deg. F., for a period of ten or twelve hours.

The spray should be continued for a sufficient length of time to cause the deposits to fall off. Then use a high pressure, high velocity jet of water, working from the top down to wash off any adherent deposits. When the economizer is clean, should be fired hard enough to provide gases above 300 deg. F. leaving the economizer, to evaporate all moisture and corrosive liquids resulting from the washing.

Air Heater

Air heater maintenance usually consists of cleaning and reducing air leakage. This may require rerolling tubes and welding them, or replacing sections of plate type or regenerative type heaters. It may be desirable to wash the surfaces on the gas side.

(*Continued on Page* 134)



Fresh Air for More Work

YOU CAN MAKE IT EASIER FOR YOUR MEN TO PRODUCE MORE WORK BY PUTTING A COPPUS BLOWER OR HEAT KILLER ON THE JOB

WHERE it's hot or stuffy, working efficiency sags.

But with Coppus "Blue Ribbon" Blowers and Exhausters on the job ...you can keep men cool and comfortable working near furnaces ... in tanks ... in underground cable manholes ... around hot processes.

They're portable, adaptable for special purposes, each one built to Coppus "Blue Ribbon" standards—which means precision-workmanship, rugged construction.

Get more work from men whose work helps win the war. Coppus Blowers and Exhausters will save those lost minutes that add up to so many wasted hours each day.

CABLE MANHOLE AND TANK VENTILATORS — BOILER MANHOLE BLOWERS AND EXHAUSTERS — HEAT KILLERS — SHIPHOLD VENTILATORS ... DESIGNED FOR YOUR INDUSTRY — ENGINEERED FOR YOU

MAIL THIS COUPON To Coppus Engineering Corp., 335 Park Avenue, Worcester, Mass. Sales offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in SWEET'S CATALOG.

PLEASE SEND ME INFORMATION ON SUPPLYING FRESH AIR TO MEN WORKING:

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fusilages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.
- ☐ drying of walls, sheets, etc., after treated with coating material.

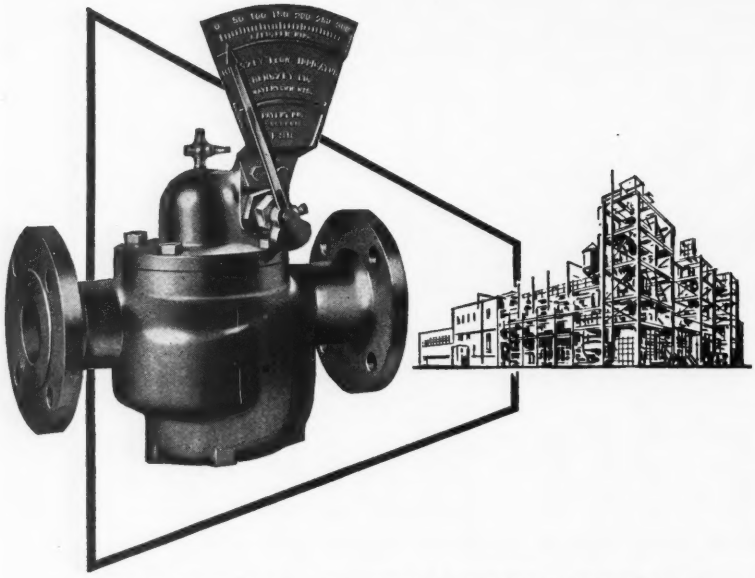
NAME.....

COMPANY.....

ADDRESS.....

CITY.....

(Write here any special ventilating problem you may have.)



HENSZEY FLOW INDICATORS
in America's
NEW "RUBBER PLANTATIONS"

The burden of providing a rubber-hungry war program with an adequate supply has fallen squarely upon the shoulders of the synthetic rubber industry. Handicapped by lack of time, materials and manpower the industry is nevertheless surmounting all current obstacles and coming through with flying colors.

In many of the synthetic rubber plants Henszey Flow Indicators are doing their bit to help make more rubber in less time with less manpower. They were chosen for this all-important job because they accurately register the rate of flow from zero to 100%. The graduations on the dial are uniformly spaced from one end to another and read direct—without constants. A long useful life, even under today's twenty-four hour schedules, is assured by the all-around rugged construction of every Henszey Flow Indicator. There are only three moving parts—so breakdowns due to complicated mechanisms are eliminated. It can be installed right in the pipe line.

If you have a flow measuring problem in your war production—write to us—we offer our years of engineering experience to help you find the solution. Among Henszey Flow Indicator users are nationally known paper mills, chemical plants, petroleum refineries, milk condenseries, and many other industries that have found a need for accurate indication of the rate of flow of all kinds of liquids.

Send for New Bulletin, FI-1

HENSZEY COMPANY, Dept. C5, Watertown, Wis.

HENSZEY

CONTINUOUS BLOWDOWN SYSTEMS

Boiler Feed Regulators • Feed Water Meters
Proportioning Valves • Heat Exchangers

(*Continued from Page* 132)

Air leakage in the air heater limits the capacity both by overloading the induced draft fan and reducing the amount of air available to the furnace for combustion. Where capacity is being limited because of the air pressure loss through an air heater, it may be found beneficial to bypass part of the air around it.

Forced and Induced Draft Fans

The forced draft fan, in general, requires little maintenance other than what might be necessary on bearings. However, one should not be lulled into a feeling that it is all right because of this. The fan may not be handling the weight of air that it was expected to handle because of entering air is at considerably higher temperature than was anticipated. It may be definitely advantageous to arrange for the fan to get cool air from outside the building.

Air heater recirculating dampers may leak, or the presence of the recirculating connections may affect the flow of air into the fan inlets. Since the recirculating connections were, no doubt, installed to prevent air heater corrosion at low loads, they are not necessary when sustained high loads must be carried, and may be conveniently removed for the duration.

Maintenance of the induced draft fan will, neglecting the effect of speed, depend entirely upon the weight and particle size of the fly-ash the fan must handle along with the gases.

It is well to determine from the manufacturer that the fan rotor is of such material that it may be welded without having to be stress-relieved or heat treated afterwards.

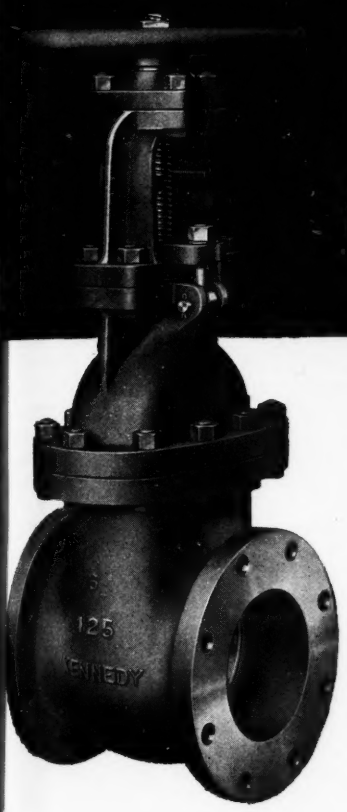
Pulverizers

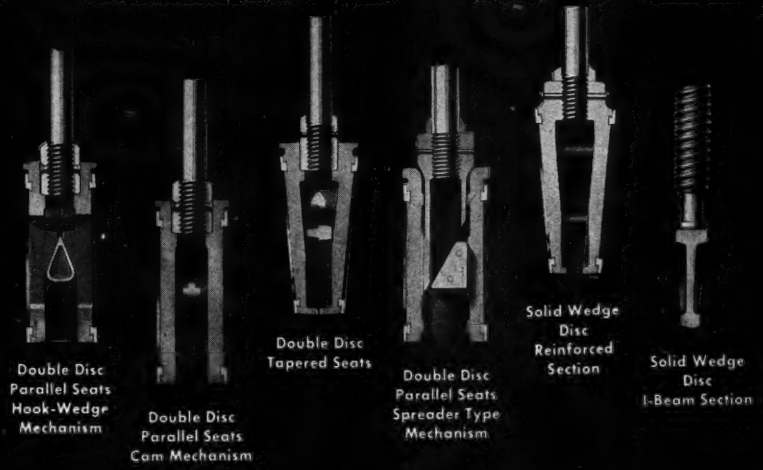
When the equipment is operated below the designed maximum capacity, or with coal at least as good as that for which the pulverizer was selected, some lack of repair can be accepted without the performance being materially affected. However, when designed maximum outputs, or outputs in excess of designed maximum, must be sustained continuously, performance will be materially reduced because the pulverizer deteriorated.

Capacity is not the only measure of pulverizer performance. Fineness of the pulverized coal must always be considered along with capacity. A good measure of pulverizer performance is the

(*Continued on Page* 136)

GATE VALVE DISCS





WHAT'S YOUR PREFERENCE?

They're all in the KENNEDY line

Solid wedge with cored or I-beam construction . . . double disc with parallel or taper sides . . . whatever may be your preference of discs for iron-body gate lines . . . are all available in the extensive line of Kennedy Valves.

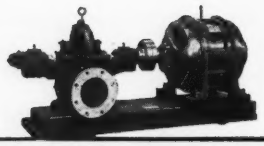
And if you would like advice as to the most suitable type for your particular requirements, the Kennedy engineers are prepared to offer authoritative recommendations, based on their long experience in designing valves for every standard requirement.

The Kennedy line includes iron-body and bronze gate, globe, angle and check valves, cast iron flanged fittings and flanges, malleable iron and bronze screwed fittings, and many valve specialties . . . all described in the 240-page Kennedy catalog which will be sent on request.

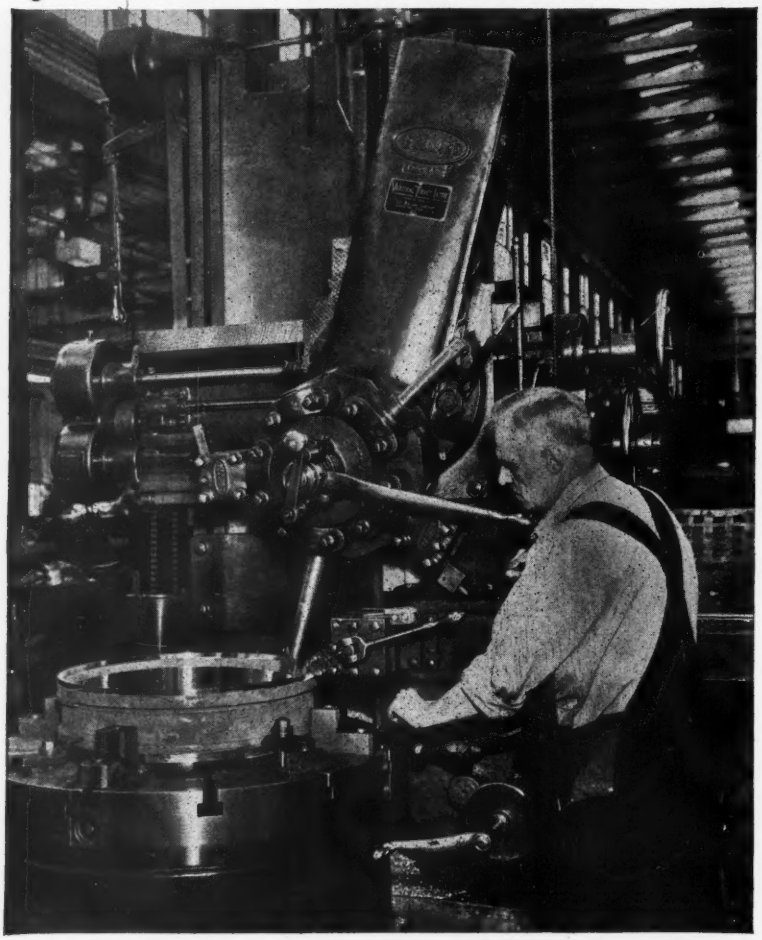
THE KENNEDY VALVE MFG. CO.

ELMIRA • NEW YORK

KENNEDY *valves . . . pipe fittings . . . fire hydrants*



Fighters on the WARREN PUMP Production Front . . No. 2 of a Series



HENRY TOOK A GUN TO FIGHT THE KAISER . . . NOW HE'S FIGHTING HITLER ON THE WAR PRODUCTION FRONT

Meet Henry Forrant . . . another patriotic American and skilled pump maker, who, for many years has been helping in the construction of Warren Pumps, built without compromise, to fit the job.

In the last war, Henry did his part on the battle field. Now, he is putting all his skill and effort into the Battle of Production . . . joining with other Warren employees to see all Warren equipment will continue to live up to their long established traditions for reliability in war-time as in peace . . . whether their duties take them to war work or sea duty.

Just as you can always count on Warren Pumps to come through under the toughest operating conditions, you can count on the entire Warren organization to help in every possible way to bring Victory to our cause.

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.
WARREN, MASSACHUSETTS

(*Continued from Page* 134)

pounds per hour of minus 200 mesh material produced. It becomes necessary to investigate fineness to determine what pulverizer repairs are required. This necessitates the careful collecting of an average fineness sample in accordance with accepted methods.

Poor burner performance, excessive slagging, high combustible loss and high furnace maintenance, all of which may reduce the maximum output of the steam generating unit, may be due to coarse grinding. The combustible in the flyash is affected by the fineness.

Burners

Burner throats should be kept in good repair. With circular turbulent type burners, especially, poor flame shape, flame impingement on side walls, as well as excessive combustible loss and localized slagging may result from burner throats having deteriorated from the original dimensions.

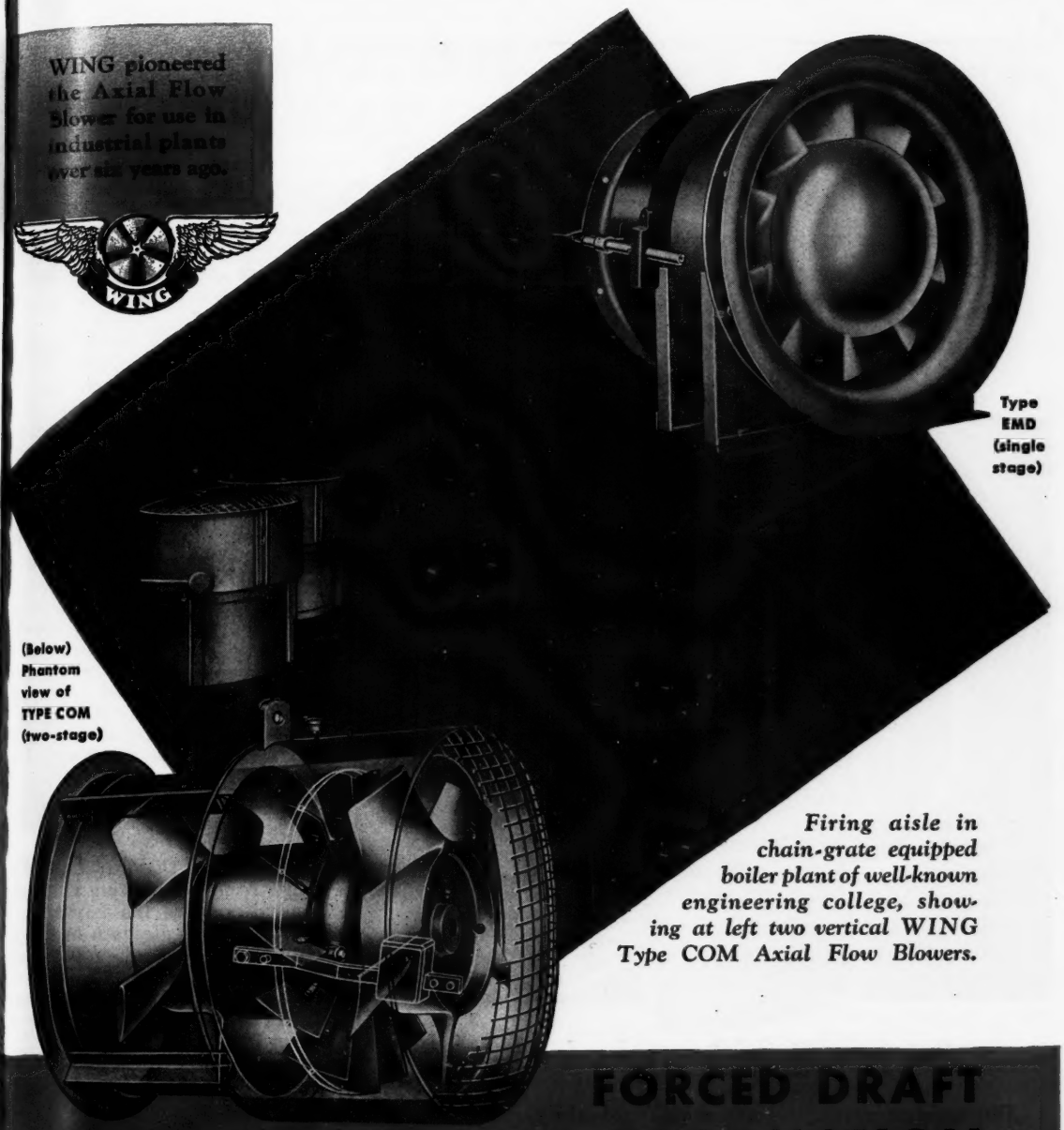
Keep the burner coal nozzles in good repair. On many types of burners, poor flame travel and lack of adequate mixing of coal and air may result from over-extending the life of the coal nozzles. Nozzles exposed to radiant heat, or where ignition has been maintained too close to the burner, may grow to such an extent that the velocity of the coal-air mixture leaving the nozzle is much lower than was originally intended. It then becomes impossible to maintain control of flame shape and flame travel.

The Unglamorous But Important Men Who Do the Work

There is a certain glamor attached to the job of building ships, aeroplanes, tanks, guns, or a big beautiful bomb or shell. There is no glamor in the job of crawling into a hot steam drum to roll a leaking tube, or furnace or boiler setting to cut out a tube that has failed, due to scaling, when, with the proper feedwater treatment, it might have been avoided, or patching up a section of refractory that you know won't last because the furnace is too hot to make a repair and the refractory won't have time to set properly.

Yet, without these maintenance men doing their job at all hours of the day or night and, often, under almost unbearable conditions, many of the workers at the more glamorous jobs would find themselves at the plant with nothing to do. I know of no instance where such a condition has arisen. For this we should be grateful to the maintenance men.

WING pioneered the Axial Flow Blower for use in industrial plants over six years ago.



Type EMD (single stage)

(Below) Phantom view of TYPE COM (two-stage)

Firing aisle in chain-grate equipped boiler plant of well-known engineering college, showing at left two vertical WING Type COM Axial Flow Blowers.

FORCED DRAFT FOR ALL-OUT WAR PRODUCTION

WING Axial Flow BLOWERS are operating on both the industrial front and the actual battle-front in supplying forced draft for the boiler plants of our great war plants and in the Navy and Maritime Shipping both for forced draft and for ventilation. These blowers are characterized by:

1. HIGH EFFICIENCY
   Total Head Efficiencies run 90% and higher
2. NON-OVERLOADING HP CHARACTERISTICS
3. GREAT COMPACTNESS
   Economy of Space and Weight
4. EASE OF CONTROL
5. QUIET OPERATION

Write for a copy of new Bulletin CO-5

L. J. WING MFG. CO. • 7th Ave. & W. 14th • NEW YORK, N.Y.

WING AXIAL FLOW BLOWERS

Old Dart Unions—
As Well as New — Provide
DISTINGUISHED SERVICE

. . . Put your *Used Darts* back into Action

Distinguished service . . . economical, *tight-joint* performance . . . that's what you can count on from a Dart Union—even though it has been used over and over again. And that is why Darts should *not* be discarded . . . but put back to work.

The explanation of a Dart's extra-values is as simple as this. Darts have extra-wide matched bronze seats, ground to "true-ball" surfaces for correct leak-proof seating and which prevent corrosion at the joint . . . clean-cut threads that prevent scoring . . . extra-heavy nuts and bodies made from High-test air-refined malleable iron that resists pipe strains and rough handling.

Get all the service that Dart Unions offer you . . . put your used Darts back into action. And see your supplier for new ones.

DART UNIONS

E. M. DART MFG. CO., PROVIDENCE, R. I.

Pure Water Without Hea

(*Continued from Page* 118)

general are formed from an o ganic base.

On the average water supply the cost of the water treatment i less than a dollar per thousan gallons, including depreciatio and maintenance; and when th supply is low in dissolved solid the cost may be considerably le —even as low as 20,000 gal. fo one dollar.

The smallest units availabl have a permissible flow of 10 g.p.h. with the larger units in creasing up to 50,000 g.p.h. Thes are not theoretical capacities, bu are obtained under normal opera ing conditions.

These units are supplied with conductivity meter (Solu-Bridge which at all times indicates th purity of the treated water. I instantly shows when that purit falls below a predetermined stand ard, as at the end of a capacit run; and, if desired, can automa ically shut off the entire unit whe this point is reached. Also indi cated is the quantity still availabl before the capacity is reached.

Operation is completely aut matic until the capacity is reache when the unit is regenerated i much the same way as a wate softener.

Liming of the ordinary still re sults from evaporating raw wate and depositing the impurities i the form of scale both in the sti itself and outside the cooling coils Because no heat is used these unit will not lime up. Maintenanc costs are therefore, materially re duced.

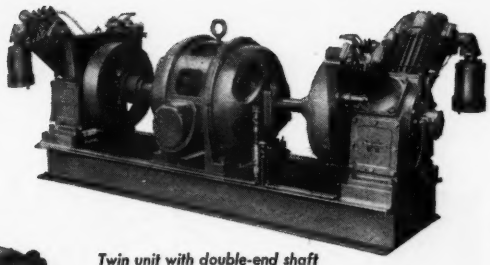
A unit delivering 300 g.p.h. oc cupies a floor space of roughly 4 by 8 ft. and a unit delivering a continuous flow of 30,000 g.p.h. occupies a space approximately 11 by 70 ft. The water is not evaporated, so no heat is used in the process. This means an important saving in fuel. Two main reactor tanks, as well as all piping carrying the treated water, are of non-corrosive materials, their nature depending on the job to be done.

In operation, water passes through two beds of special resins, the first of which removes by base exchange, the positive ions, such as calcium, magnesium, sodium, iron, etc., substituting hydrogen. The hydrogen combines with the negative sulphate, chloride, nitrate, etc., ions to form the equivalent acids. (The carbonates form carbonic acid which passes on

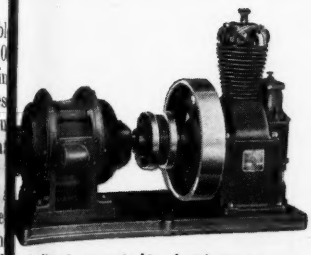
(*Continued on Page* 140)

WORTHINGTON

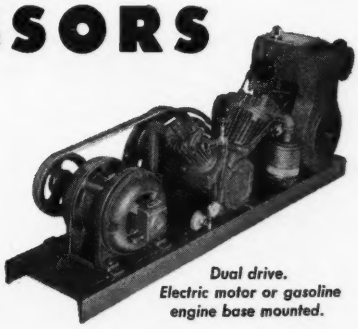
Vertical COMPRESSORS



Twin unit with double-end shaft motor on steel base



Unit direct connected to electric motor



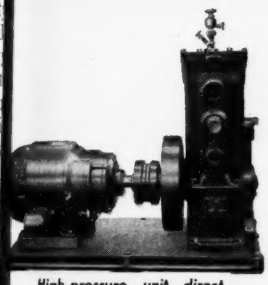
Dual drive. Electric motor or gasoline engine base mounted.

24 Sizes

344 Arrangements

Capacities to 164 c.f.m.

Pressures to 1000 lbs.

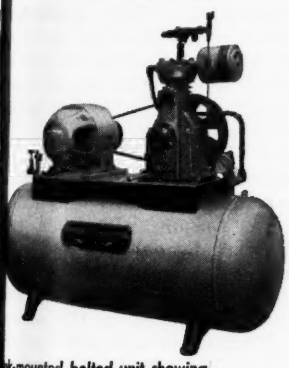


High-pressure unit direct connected to electric motor

War production plants are now using these units in a total of more than two million horsepower. To any plant whose needs for compressed air fall within the above range, Worthington compressor equipment offers advantages that can contribute greatly to stepped-up output. They are built for users who demand the best equipment.

The following features make Worthington compressors the choice of careful purchasers.

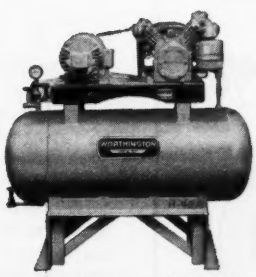
- One-piece Feather Valve . . . lightest, simplest, most efficient.
- Close-grained nickel iron cylinder, honed to mirror surface . . . generously finned for efficient cooling.
- Ground piston, closely fitted in cylinder . . . two compression rings and two oil rings . . . for oil-free air discharge.
- Full-floating wristpin . . . retainer spring prevents scored cylinder.
- Extra-long drop-forged heat-treated connecting rod . . . reduces cylinder wear. Shim-adjusted babbitt crankpin bearing. Graphite-bronze wristpin bushing.
- Drop-forged heat-treated integrally-counterbalanced crankshaft . . . journals ground and polished.
- Adjustable Timken main bearings . . . controlled splash lubrication.
- Force-feed lubrication to all shaft bearings . . . adjustable babbitt main bearings.
- Shaft oil-seal keeps compressor installation clean and oil-free.
- Crankcase ventilator . . . well baffled . . . keeps oil in, and dust out.
- Cast-iron belt wheel with fan spokes . . . good cooling decreases power required



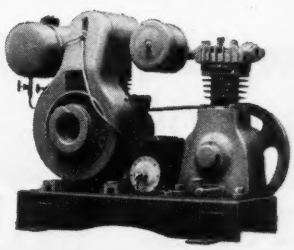
k-mounted belted unit showing pressure regulator control

Worthington vertical compressors are available to those manufacturers whose war production activities give them priority. An authorized Worthington industrial dealer or district office engineer will be glad to assist you with the correct selection for your requirements.

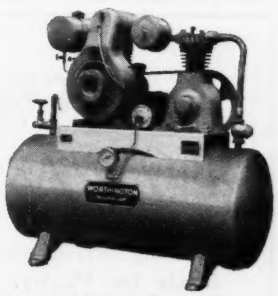
Unit mounted on Massachusetts code vertical tank



Massachusetts code horizontal tank-mounted compressor unit



Base-mounted unit with gasoline engine drive



Tank-mounted unit with gasoline engine drive

CB-1

WORTHINGTON PUMP AND MACHINERY CORPORATION • HARRISON, NEW JERSEY

PYREX BROAD

Chief Engineer Martin's Assistant has joined the Marines...

Two of his men have been drafted—a third is working in an airplane factory. That's the story in a good many power plants. And when a plant is short-handed, changing a broken or leaky gauge glass is more of a nuisance than ever.

You know that *all* gauge glasses make trouble when improperly installed. If a glass is too long or too short, it soon needs attention. If it's badly aligned, it's subjected to ruinous stresses. If the wrong washers are used, grief will result.

You also know, as well as we do, that *all* gauge glasses give out. No gauge glass in the world resists steam action indefinitely. Sooner or later it wears thin at the top, but—PYREX gauge glasses wear *later* instead of *sooner*. They last longer, and that's why thousands more engineers are today telling their jobbers to send them PYREX glasses. And for added value, they ask for PYREX Broad Red Line glasses—the kind that are easy to read from a distance. It's a lot more than a play on words to say it pays to save steps when you're short-handed.

"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works, Corning, N. Y.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

Be 100% with your 10%

Buy WAR BONDS

Qualify for the 10 Per Cent Club by investing 10% of your earnings in War Bonds for Victory. Show Uncle Sam you're glad you're an American and are willing to *invest* your money to stay one!

10%

(*Continued from Page* 138)

through as CO_2 and water, and t
CO_2 can be very largely dispell
by aeration if its presence is un
sirable.) This acid water pass
to a second tank where the neg
tive ions (chlorides, sulphat
nitrates, etc.) are removed by a
sorption, giving a final efflue
which compares very favorab
with single-distilled water.

These units assure reprodu
bility of laboratory results in fa
tory operation, regardless of t
quality of the water supply. W
ter produced by this method
uniform at all times.

Synthetic Ion Exchange Resins

One of the most significant r
cent developments in the field
synthetic resins was the discove
by Adams and Holmes in Engla
in 1935 that certain synthetic re
ins, when correctly formulate
can function very efficiently
cation or anion exchangers. Th
discovery broadens the scope
synthetic resin applications
many new and hitherto untouch
fields. Whereas, previously,
resin was measured mainly
terms of its plastic properties a
chemical inertness, now, in t
case of ion exchangers, a suitab
resinous product is selected on t
basis of physical rigidity a
chemical activity.

The entire field of natural a
synthetic resins has been review
with the focus of attention
chemical behavior to discover t
most suitable types for use in t
purification of water.

The chemical phenomenon
ordinary base-exchange exhibite
by certain naturally occurrin
complex sodium aluminum sil
cates, whereby calcium and mag
nesium ions in water are replace
by sodium ions, is well known an
has been employed in the soften
ing of water in industry and i
the home. The naturally occurrin
silicates (zeolites or greensands
first used were later improved b
chemical treatment in some cases
while in others synthetic "artifi
cial" zeolites with higher exchang
capacities were developed. Thes
inorganic materials have been suit
ed for applications where decreas
of hardness is the main require
ment. However, the total dis
solved solids content of the treate
water must, on the basis of chem
ical equivalencies, be higher tha
that of the raw water. Furthermore
if the carbonate or bicarbonate con
tent of the raw water is high, th
alkalinity after treatment may b

(*Continued on Page* 144)

2 ways to clean Turbines

1 This way's always a lot of work

Safe cleaning practice. When turbines have operated on oil that has developed excessive sludge and acidity, all trace of contaminants should be removed before refilling. Any contaminants left in the system will speed up deterioration of the new oil. Here are highlights of safe practice:

1 Completely drain the system of old oil.

2 Remove the oil cooler and completely clean it of deposits and old oil.

3 Clean the oil reservoir and precipitation tanks.

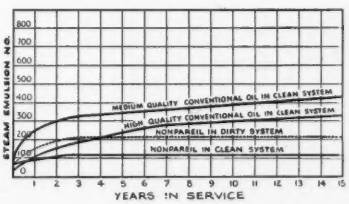
4 Remove bearing caps and end plate, and clean recesses in and around bearings and pedestals.

5 Clean screens and filter or centrifuge.

6 Examine piping layout to determine if it will completely drain. If there are low places or pockets, open up pipe joints at suitable places to insure complete drainage. If possible, pipes should be wiped by drawing rags through them.

7 Clean the governor mechanism, bleeder valve operating mechanism, and oil-operated throttle. It is usually necessary to remove hand plates to insure complete cleaning of the pockets and recesses in the governor mechanism.

All who are familiar with turbine operation know that the foregoing is a bare outline of necessary steps which involve many hours of labor and down time.



Above chart shows that the S. E. number of Nonpareil Turbine Oil remains fairly constant in service, while that of conventional turbine oils tends to increase, due to acidity and sludge. The two lower lines show the advantage of thoroughly cleaning a turbine before installing new oil

2 This way you do the work only once

Use Nonpareil Turbine Oil, and you need clean your turbine only once—at the time of the original fill.

Why Nonpareil keeps turbines clean. Turbines need cleaning if and when they develop excessive deposits in the oil system. Basic cause of such deposits is oxidation—the absorption of oxygen by certain unstable hydrocarbons in the oil. There are two main types of these unstable hydrocarbons—one forms asphaltenes, the other, organic acids.

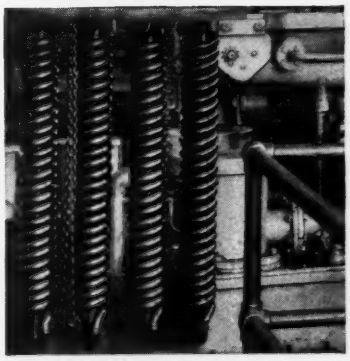
In the refining of Nonpareil, all of the asphaltene-forming hydrocarbons are removed—which completely eliminates this type of deposit. This statement can be made about very few oils.

We know of no refining process that will remove *all* acid-forming hydrocarbons. But we render them permanently harmless in Nonpareil by the addition of a patented inhibitor. This lets us guarantee the neutralization number of Nonpareil never to exceed 0.15 for the life of the turbine. In actual service, it is more likely to be around 0.05, as hundreds of turbines have proved after 5 to 15 years of operation. *This* claim can be made for *no* other oil.

Thus, with the two basic causes of deposits removed, Nonpareil stays clean—retains its new-oil condition. Use it, and you'll never again need to clean your turbines.

A Standard Lubrication Engineer will gladly furnish details, service records, and other proof. Just write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois, for the Engineer nearest you.

OIL IS AMMUNITION . . . USE IT WISELY



Unretouched photograph showing cooler coils from a steam turbine after 10 years of operation on the same batch of Nonpareil Turbine Oil without change. Note cleanliness.

★ ★

NONPAREIL TURBINE OIL

★ ★

STANDARD OIL COMPANY (INDIANA)

•LUBRICATION ENGINEERING••LUBRICATION ENGINEERING••LUBRICATION ENGINEERING••LUBRICA

NEW Stanobar GREASE

It's a war-bred grease for ball and roller bearings

• ALREADY accepted as a veteran—while still a rookie—Stanobar Grease No. 2 is giving a splendid account of itself on wartime production lines. Today's swift pace demands this new type grease. Longer hours of operation alone call for a more stable grease to resist heat and oxidation, while the need for more frequent lubrication of bearings makes an easily-handled gun grease an asset.

Stanobar brings you both these advantages. It's a smooth

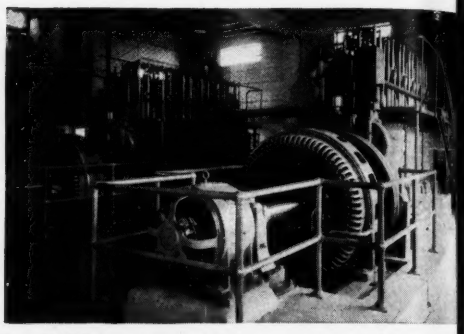
(not fibrous) type grease that flows readily through grease guns. It contains inhibitors which reduce oxidation of both the soaps and oil in Stanobar. That means less cleaning of bearings, and less labor and lubricant required to flush out old grease.

Stanobar resists thinning out when worked—that helps reduce leakage. It may also enable you to replace two or three grades of grease you are now using with this one grade of Stanobar.

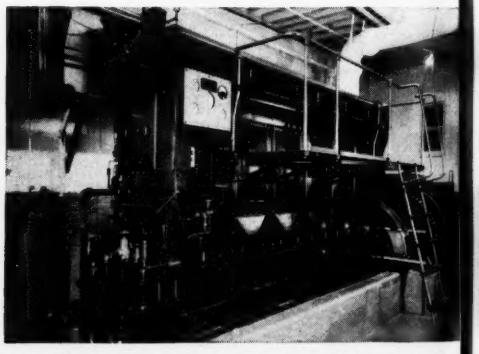
Let a Standard Lubrication Engineer explain some of the other advantages of new Stanobar—and help you make a test.

How to get more power out of your present Diesels

Power shortage? Make this your answer: Get more work-hours from your present Diesels. Cut down time for cleaning carbon and sludge. Reduce power loss through stuck rings, worn liners, and carbon deposits, as these operators have done.



Over 20,000 hours of trouble-free operation on Nonpareil in a 150 HP Diesel influenced the selection of Nonpareil Diesel Oil for the two 500 HP units, of the type pictured above, in a central state foundry. Now, after 10,000 hours on each of these engines, Nonpareil is repeating the performance—low maintenance, and no ring sticking, cleaning, or forced shut-downs.



Oil trouble cleared up with the first test of Nonpareil Diesel Oil is the report from a Michigan industrial plant. The change to Nonpareil was made after the oil that had been put into the new unit, above, thickened within a short time. Nonpareil has operated for three years now, for periods five times as long, without thickening.

As the first step to boost power output, check the oil you are using. A Standard Lubrication Engineer will be glad to help you. Just write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois, for the Engineer nearest you. In Nebraska, write Standard Oil Company of Nebraska at Omaha.

NONPAREIL DIESEL OIL

OIL IS AMMUNITION . . . USE IT WISELY

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

OUR JOB FOR 1943

Our first "order of the day" during 1943 is — PRODUCE MORE AUTOMATIC CONTROL EQUIPMENT for the merchant marine, the navy, the synthetic rubber and aviation gasoline programs, and other critical war-time requirements. Fisher Automatic Controls occupy a key position in the fulfillment of these and many other war production schedules.

This equipment is necessarily receiving first attention in our plant — it is a "must" obligation to the production drive for victory. As a result we are unable to make delivery on your orders as quickly as in the past.

However, we have taken definite steps to improve the situation and the results are already apparent. We point with pride to these accomplishments — all aimed at PRODUCING MORE AUTOMATIC CONTROL EQUIPMENT IN 1943!

INCREASED PRODUCTION

Already Fisher production is 100% above 1942. Our round-the-clock work schedules call for three eight-hour shifts seven days every week.

INCREASED PERSONNEL

Today, the largest working force in the history of our company is constantly striving to produce Fisher Control Equipment in record-breaking quantities. Every member of our organization is mindful of the job that confronts us and is pledged to do something about it.

INCREASED PLANT FACILITIES

The entire Fisher Plant is "streamlined" to producing more essential control equipment. More floor space — relocation of departments and equipment have made possible more efficient manufacturing methods as well as greater production.

INCREASED MACHINE CAPACITY

To an already impressive and modern array of manufacturing equipment, many latest design machines have taken their place in Fisher production lines to further speed delivery of automatic controls. Materials and workmanship are maintained to Fisher's high standards.

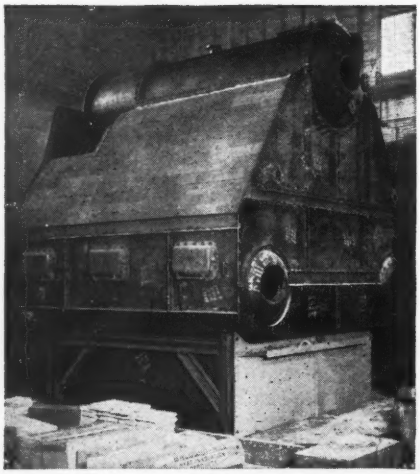
SIMPLIFICATION OF TYPES AVAILABLE

Elimination of many types from the Fisher line for the duration means faster delivery on standard types. Should you order a discontinued item, we ask your co-operation in accepting the recommended standard design . . . remembering that Fisher guarantees satisfactory performance regardless of the substitution.

FISHER GOVERNOR COMPANY
• 1014 FISHER BUILDING •
MARSHALLTOWN, IOWA

For ANY Service up to 1600° F

BALDWIN-HILL MONO-BLOCK Has Marked Advantages



A standard-type industrial boiler being insulated with Baldwin-Hill Mono-Block. This picture shows the application of the Mono-Block on the sides of the boiler.

Baldwin-Hill Mono-Block installed in heat treating furnace. Effective up to 1600°, Mono-Block is ideally suited for insulation of heat treating equipment.

If you buy insulation for *any* purpose, it will pay you well to investigate Baldwin-Hill Mono-Block! Here is a single product for *all* high temperatures—clear up to 1600° F. Here is a block that cuts like bread, absorbs rivet heads and welds to fit close and tight, cements into place, and lays up fast, yet carries its own weight easily and permanently. Here is an insulation which does not disintegrate under moisture, and which has remarkably low thermal conductivity.

Investigate B-H Mono-Block. Write us for a free sample. See for yourself its felted structure, its black rock-wool content, and its unusual workability. Write today.

BALDWIN-HILL *Insulations*

577 KLAGG AVE. TRENTON, N. J.

NEW YORK • CHICAGO • KALAMAZOO

(*Continued from Page* 140)

excessive. Since excessive alkalinity has been held responsible for (1) an increase in the amount of silica extracted from the zeolite beds, (2) a probable increase in the danger of embrittlement in boilers, and (3) "snowy" ice in ice manufacture, the disadvantages of such a method are obvious.

The treatment of certain "carbonaceous" materials, such as peat, coal, lignite, wood, etc., with fuming sulfuric acid, chlorosulfonic acid, etc., produced compounds which were capable of ion exchange. Such materials contained less silica than the siliceous zeolites, hence were better suited to withstand the action of acids and may be converted to their hydrogen derivative. Metal ions may be removed from an aqueous medium and replaced with hydrogen ions, whereby the salts are converted to corresponding acids.

The total dissolved solids, and hardness, were thereby reduced. The carbonates and bicarbonates could be removed by conversion to carbonic acid, which was eliminated by simple aeration. The water treated with a hydrogen exchanger was blended with raw water, or with water treated with a sodium ion exchanger, to reduce the acid content of the water, lower the total solids, and effect a removal or reduction in hardness.

The discovery of Adams and Holmes in 1935 that ion exchange properties are possessed by synthetic resins of certain composition has opened the door to incalculable opportunities for the chemist, since these ion exchange resins may not only be used in all applications in which carbonaceous exchangers have heretofore found employment, but, in addition, have the added properties of very high efficiencies and high capacity.

In addition to the cation exchanger, which operates either in the "sodium" or "hydrogen-cycle" the versatility of organic chemistry has led to the development of an entirely new type of exchange-absorbent, the anion exchanger resins, which remove acids from solution. Thus for the first time, it is possible to remove the salts from aqueous solutions.

The author is indebted to the Illinois Water Treatment Co. of Rockford, Ill., and The Resinous Products & Chemical Co. of Philadelphia, Pa., for considerable of the foregoing data and information.

A thought addressed to those who need small diameter valves for precise, severe throttling services that are handled best by Bar Stock Valves.

In 1940, Lend-Lease made its call for Bar Stock Valves. But, there was still ample capacity for American industry.

Then came war—cargo and warships, high octane gasoline, raw materials for synthetic rubber, munitions, aircraft—all under wartime drive, demanding Bar Stock Valves because they provide the best means for precise, severe throttling.

That is the answer to the question: "Why don't we get Bar Stock Valves?"

We of Reading-Pratt & Cady are giving to this war production all we've got, turning out these finely made valves in volume by methods that will be of value to you when the war end makes it possible to resume the kind of business we prefer—making valves for a peaceful America.

READING-PRATT & CADY BAR STOCK VALVES
Sizes up to 1"

Globe, Cross, Angle, Plug-Type . . . Precise, automatic production . . . Long seating contact. Fine spindle threads. For severe throttling services. Steam, water and other fluids. Ratings: from 4000# at 150° F. to 475# at 1000° F.

READING-PRATT & CADY

MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

Reading, Pa., Atlanta, Boston, Chicago, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco, Portland

A DIVISION OF **AMERICAN CHAIN & CABLE COMPANY, Inc., BRIDGEPORT, CONNECTICUT**

★ Simple
★ Rugged
★ Reliable
★ Made in U. S. A.

. . . the JONES heavy duty HAND TACHOMETER

Here is a rugged American-built Hand Tachometer . . . available for delivery, in accordance with your priority rating.

We suggest the Jones Heavy Duty Hand Tachometer for indicating rpm and surface speeds of all types of machinery in which the moving parts are readily accessible.* It is built to "stand the gaff" and maintain accuracy in hard, everyday service. Single and triple range models up to 12,000 rpm. Instruments are furnished complete with carrying case, including extra tips. Rubber-tired wheel for measuring surface speeds available at slight additional cost.

Write for new descriptive Bulletin 1710-PE

*Where moving parts are not readily accessible, as in turbines, centrifugal pumps and other totally enclosed machines, and also for measuring vibrations per minute, we recommend our Frahm Vibrating-Reed Tachometers. Ask for Bulletin 1590-PE.

James G. Biddle Co.
1211-13 ARCH STREET *Electrical and Scientific Instruments* PHILADELPHIA, PA.

THE NATIONAL ROSTER OF SCIENTIFIC AND SPECIALIZED PERSONNEL

THIS WAR NEEDS PROFESSIONAL PEOPLE!

HAVE YOU PROFESSIONAL TRAINING OR EXPERIENCE IN:

1. Engineering and/or related fields?
2. Physical sciences?
3. Agricultural and/or biological sciences?
4. Medical sciences and/or related fields?
5. Social Sciences?
6. Administration and management?
7. Humanities — foreign languages; philosophy?

AND ARE YOU:

1. Unemployed, because construction work has been stopped, or for other reasons?
2. Employed in less-essential activity and seeking a transfer to war work?
3. Working, but feeling that your abilities are not fully used on your present job?

WRITE A LETTER NOW TO:

The National Roster of Scientific and Specialized Personnel War Manpower Commission
Attention: Qualifications Section
Washington, D. C.

In your letter state:

1. Whether you are now available for employment;
2. Types of work you are qualified to do;
3. Conditions under which you will accept employment;
4. Whether you are or are not already registered with the Roster — If you are not already registered with the Roster, state your field or fields of specialization and request registration papers.

NOTE: Even if you are already registered, the Roster, now a part of the Bureau of Placement, War Manpower Commission, needs to know whether you are PRESENTLY AVAILABLE for employment.

YOU CAN BANK ON FAIRBANKS

for "SPHERO" BALL VALVES

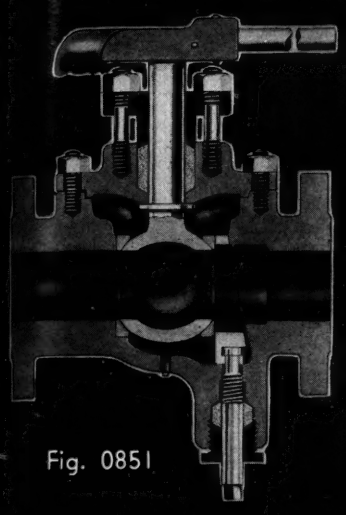


Fig. 0851

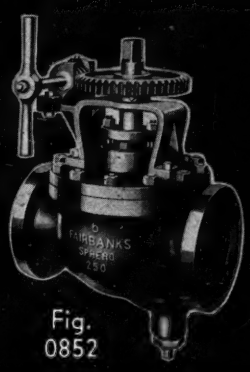


Fig. 0852

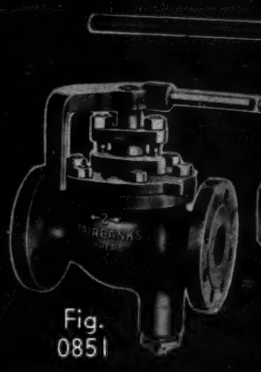


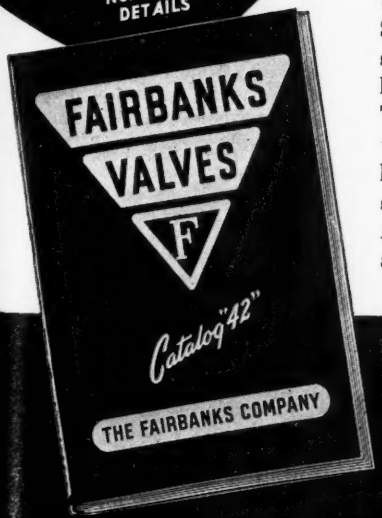
Fig. 0851

Fig. 0850

OTHER FAIRBANKS VALVES

Bronze Globe, Gate, Angle Cross and Check Valves
Iron Globe, Gate, Angle, Cross and Check Valves
Faircoseal Bronze Valves
U-Bolt Gate Valves
Asbestos Packed Cocks
Bronze Radiator Valves
Sphero Ball Valves

CONSULT FAIRBANKS NEW CATALOG No. 42 FOR DETAILS



For Blow-Off Purposes and Services Where A Full-Flow, Quick-Opening Valve is Desired

SERVICE: Recommended for service on steam, water, oil, gas and chemical lines. Available for pressure of 250 lbs.

TYPES: Fairbanks Sphero Valves are regularly furnished with a semi-steel or chrome nickel alloy body and bonnet, with bronze, iron, or cast-steel ball, operated by a lever or worm and gear. Can also be supplied in cast steel with stainless-steel ball and Ni-Resist steel rings.

FEATURES: Instead of the usual wedge or disc, Fairbanks Sphero Valves have a *revolving* Ball Plug which wipes seating surfaces clean. Its shearing action cuts through heavy solids and liquids. There is nothing on which foreign matter can accumulate. The opening in the Ball Plug is the same size as that in the pipe—there are no obstructions, no frictional resistance. Whether handling heavy viscous fluids or light gases, it has a leak-proof seal. Can be opened or closed with a quarter turn of handle. A positive stop tells when fully open or closed. There is an easy adjustment to take up wear.

THE FAIRBANKS COMPANY

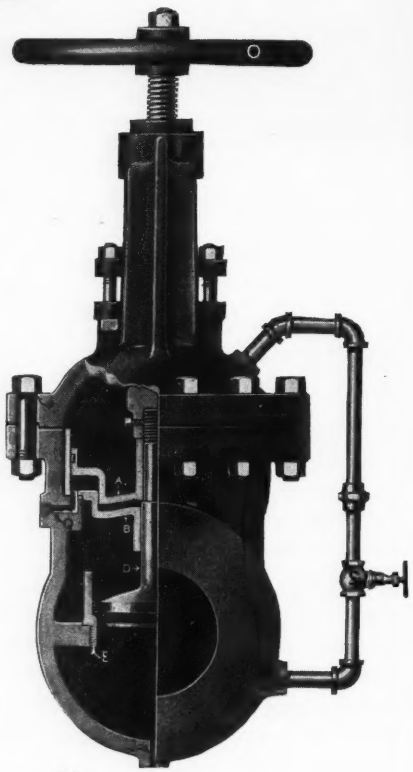
393 LAFAYETTE ST., NEW YORK, N. Y.
BOSTON, MASS. PITTSBURGH, PA.

Distributors in Principal Cities

4 SAFETY-FIRST FEATURES OF THE GOLDEN-ANDERSON *Engine Stop Valve*

With G-A's Throttle and Emergency Stop Valve, your plant is protected against damage to valuable property because:

1. It automatically shuts down any over-speeding engine or turbine.
2. It works instantly — mechanically, electrically, or by hand; may be tripped by a push button from remote points.
3. Its positive shaft governor may be easily adjusted for any tripping speed.
4. Double Corliss cushioning arrangement prevents possibility of pounding or spinning—provides added dependability.



Sectional view shows valve seated with hand-wheel run up for automatic operation, and valve in bypass open. Pressure underneath disc D opens the valve which is balanced by flow of pressure through bypass above dashpot A and into the annular space between dashpots. For a more detailed description of the complete G-A line, write today for Free Catalog.

Also

Triple Acting Non-Return . . .
Altitude Control . . .
Float Control . . .
Pressure Reducing . . .
Check Valves, etc.

GOLDEN-ANDERSON VALVE SPECIALTY CO.
Fulton Building • • • Pittsburgh, Pa.

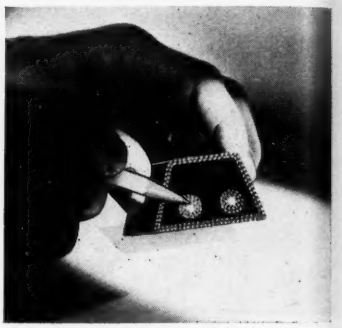
NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. WRITE POWER PLANT ENGINEERING

Wire Reinforced V-Belts

PRODUCTION OF WIRE REINFORCED V-BELTS is announced by The B. F. Goodrich Company, which first built belts of this type in 1938.

Two types are being built, a cable cord construction and a grommet construction which incorporates a wire cord placed in the center of a cotton or rayon grommet.



The company emphasizes that only after full engineering details of the equipment on which the belt may be used and operating conditions are studied will it be able to decide whether a wire belt will be practical.

High-Speed Relay for Generator Protection

A NEW GENERATOR differential relay, Type CFD, for use in generator protection, has been announced by the General Electric Co. It is a high-speed, induction-cylinder device, incorporating a new principle called "product restraint" with variable slope characteristics.

This new combination eliminates the difficulty previously encountered with high-speed generator relays due to the transient current transformer errors on heavy through faults.

The relay is 20 5/16 in. by 5½ in. in the standard 3-element drawout case, and can be supplied for surface or semi-flush mounting. Each element of the relay is of the familiar eight-pole, induction-cylinder type. Three poles are used for the differential operating function, and three poles provide the "product restraint."

Cromox Refractory Coating

CROMOX, a protective refractory coating material for prolonging the life of fire brick, insulating fire brick, and castable refractories in coal, oil, gas-fired and electric furnaces, as well as in non-ferrous melting furnaces, has been announced by Federal Refractories Corp., Akron, O., a unit of The United States Stoneware Co.

Cromox is a liquid, applied by brush, spray gun or dipping, made of non-critical materials, delivered ready to use on either hot or cold surfaces. Cromox, it is claimed, will withstand temperatures

WeldELLS have everything ★

NO GUESSWORK HERE—

THE welder's job is *welding;* not fussing around to find a fitting of the right size and weight —or waiting for the other fellow to do it. And yet that is just what he's up against when he works with fittings that are not clearly identified. When such things happen it isn't surprising that the welder may "take it out on the job"—particularly when he's working against time as most everyone is today.

Anything can happen when unmarked or poorly marked fittings are used. The wrong size may be delivered, and not discovered until too late. A helper may lug a heavy fitting a long way from the stockroom, only to do it all over again.

But there's little chance of this sort of thing when the fittings are WeldELLS* or other Taylor Forge Welding Fittings. Every Taylor Forge Fitting wears its size and weight on its back—permanently marked so that it can be read ten years from now as well as it can today!

By eliminating the danger of using wrong thickness fittings, this feature ranks with the many features of WeldELLS that contribute to sound engineering design. And by simplifying and speeding up welding, it ranks with the many features that contribute to convenience and economy.

Yet it is just one of many reasons why WeldELLS are known as the fittings that have *everything*—everything *any* welding fitting has; some things that no other has.

TAYLOR FORGE & PIPE WORKS

General Offices & Works: Chicago, P. O. Box 485

● WeldELLS are just one of many Taylor Forge Products that are vital to war and victory. An example is huge rolled steel rings—an important part of U. S. tanks now in action.

★WeldELLS alone have all these features

In addition to the feature described, they include:

▶ **Seamless**—greater strength and uniformity.

▶ **Tangents**—keep weld away from zone of highest stress—simplify lining up.

▶ **Precision quarter-marked ends**—simplify layout and help insure accuracy.

▶ **Selective reinforcement**—provides uniform strength.

▶ **Wall thickness never less than specification minimum**—assures full strength and long life.

▶ **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.

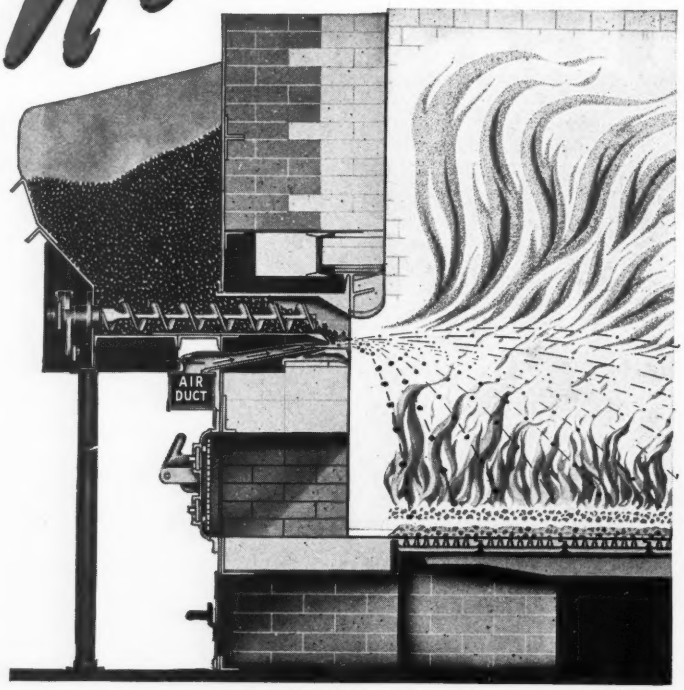
▶ **The most complete line of Welding Fittings and Forged Steel Flanges in the world**—insures complete service and undivided responsibility.

* * *

* WeldELLS and many other Taylor Forge Products are produced in Byers Genuine Wrought Iron.

NEW YORK OFFICE: 50 CHURCH STREET • PHILADELPHIA OFFICE: BROAD STREET STATION BLDG.

Now IS THE TIME



TO THINK ABOUT *NEXT WINTER'S STEAM!*

IF you are burning oil, present reports indicate that the sooner you change over to coal the better. If you are burning coal, you want best possible results and you'll be better fixed if you can burn local coals or cheap coals. In either case NOW is the time to plan on installing FYR-FEEDER Multiple Spreader Stokers. You'll get delivery in time, installation in time and can select your coal in time.

FYR-FEEDERS burn coal like oil, burn *any* coal, produce steam quicker, increase boiler capacity, are easy to operate. Get all the facts NOW.

Write for Catalog

Describes FYR-FEEDER operating principles and exclusive design features. Shows typical installations, write today.

AMERICAN COAL BURNER COMPANY

ENGINEERS • ESTABLISHED 1918

Builders of thousands of industrial stokers

22-18 E. Erie St. **Chicago, Illinois**

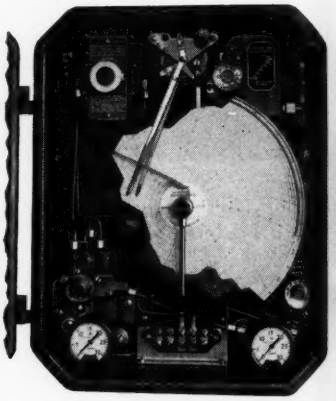
up to 3000 degrees F., will not crack, peel, blister or bloat as it becomes an integral part of the refractory to which it is applied and expands and contracts with it. It is designed to resist flame erosion, reduce spalling and be unaffected by the attacks of slags, alkalies, acids and moisture.

Automatic-Manual Unit for Process Controllers

ALTHOUGH automatic control for continuous processing is more and more in demand by modern industry it is often desirable to exercise manual control.

To meet this demand for supplementary control, Taylor Instrument Companies, Rochester, N. Y., now offer a new automatic-manual control unit.

When the new Unit is in a "manual" position, controlling air pressures are also applied to the idle mechanism of the fulscope controller which is thus maintained in constant balance with the process. Because of this balance, control can be changed instantly from "manual" to "automatic" without causing process disturbances.



In addition to the three usual positions, "automatic", "manual" and "service" this new unit contains a fourth step, "test". Set at "test", control is manual but the full 20 psi. supply pressure is applied to the instrument mechanism to make possible its complete and accurate readjustment without disturbing the position of the controlled diaphragm valve.

The Automatic-Manual Unit is designed to be installed entirely within the case of a Fulscope Single Duty Recorder Controller. It can be supplied already installed in new instruments, or it may be added to equipment already in the field, without the need of either drilling or tapping the Fulscope Instrument. All tubing is supplied preformed for ease of attachment.

Heat Exchanger

The "Shellfin", a standardized heat exchanger suitable for most uses and built on a production basis, is a new product of Downingtown Iron Works, Downingtown, Pa.

With only minor changes in its basic construction, such as baffle spacing and length combinations of units, the "Shellfin" can be used for many forms of heat exchange between two fluids in medium temperature ranges where temperature of one fluid materially exceeds that of the other. It adapts perfectly to cooling, heating, condensing and evaporating processes.

ONE of FOUR

Surface Condensers
Totaling 122,000 Square Feet

Typical of larger surface condensers designed and built by Lummus is this 36,000 square foot unit for a well-known public utility. Precision workmanship in the Lummus Company plant will facilitate easy and accurate assembly in the field.

All Lummus condensers are equipped with air ejectors designed and built by Lummus.

DESIGN FEATURES
LUMMUS SURFACE CONDENSERS

- Streamlined Tube Layout
- Internal Air Cooling Section
- Deaerating Hotwell

RESULTING IN —

- Minimum Pressure Drop
- Minimum Condensate Depression
- Minimum Condensate Oxygen Content
- Minimum Air Ejector Steam Requirements

THE LUMMUS COMPANY · 420 LEXINGTON AVE., NEW YORK, N.Y.

LUMMUS

USE OF PROPER METAL

CUTS BEARING FAILURES TO A MINIMUM

Bearing failures can be reduced to a minimum by using a metal that has been "alloyed" specially for the particular application. No one bearing alloy incorporates all the physical characteristics needed to meet all possible working conditions. Average conditions call for good resistance to compression plus excellent anti-frictional qualities. Under extreme conditions some of the anti-friction qualities must be sacrificed to obtain either malleability or hardness. Of the five Magnolia Bearing Metals listed below ONE is RIGHT for your application.

PHYSICAL CHARACTERISTICS

BEARING METAL	ULTIMATE STRENGTH lb. per sq. in.	YIELD POINT lb. per sq. in.	BRINELL HARDNESS	POURING RANGE deg. Fahrenheit
ADAMANT Super-Genuine	12,850	8,625	22.8	875-1050
DEFENDER	16,100	7,685	19.5	850-900
MAGNOLIA Anti-friction	17,500	5,440	21.8	825-900
POWER Nickel-Genuine	17,500	10,850	27	900-1000
PYRAMID	17,850	8,875	24	875-1000

80% of bearings in use today are subject to uniform speed and only moderate pressures, as in electric motors, line shafting and general machinery. For such services, use Magnolia Anti-friction Metal.

When bearings are subjected to heavy sustained pressures, such as in rolling-mill machinery, use lead-base Pyramid or tin base Power, hard metals which will not squeeze out.

For shock loads, which would crack the harder bearing metals, use lead-base Defender or tin-base Adamant, tough yet malleable metals. Internal combustion engines and trap rock crushers are typical applications.

GENERAL USE

HEAVY LOADS

SHOCK LOADS

NEW BULLETIN

Write for FREE 8-page bulletin which shows what bearing metal to use where and gives many helpful hints on how to keep bearings on the job.

MAGNOLIA METAL CO. • ELIZABETH, N. J.

MAGNOLIA BEARING METALS

The standardized construction eliminates much usual preliminary engineering; having standardized performances and pressure curves, unit selection can be made easily.

Varnish Stripper

A STRIPPING MEDIUM, designated as Sterling S-159 Stripper, which provides fast and easy removal of insulating varnish from portions of the electrical equipment where varnish is not desired, has been developed by The Sterling Varnish Company, 166 Ohio River Boulevard, Haysville (suburb of Pittsburgh), Penna.

Time of complete finishing of armatures, stators, rotors and other electrical units with insulating varnish has been measurably reduced with the introduction of this medium. It eliminates the tedious and harmful scraping methods heretofore employed in removing varnish which may have splashed or drained on parts of the apparatus which should be varnish-free.

Sterling S-159 Stripper is a blue viscous liquid which is brushed on machined surfaces or other metal parts prior to the actual application of the varnish to the piece as a whole. It dries in 2 or 3 min. after which the varnish is applied in the usual manner; dipping, spraying or brushing; dried at normal or elevated temperatures.

When the complete varnish treatments are finished, any varnish which has adhered to the portions previously treated with the S-159 Stripper can be easily and rapidly removed with a wood or bakelite knife without marring or otherwise disturbing the exact and close tolerances.

All-Purpose Fluorescent Fixtures

A NEW IDEA in fluorescent fixture design has been developed by the Mitchell Mfg. Co., Chicago, to meet governmental requirements and yet give war industry the fluorescent lighting it needs today. The new Mitchelite is a complete innovation. It meets all WPB and U. S. Bureau of Standards regulations, including the latest WPB Amendment to Limitation order L-78 (40-watt Mitchelite units contain less than 3 pounds of steel per fixture, 100-watt units contain less than 4 pounds of steel per fixture). At the same time, it retains every good lighting feature of the past and adds new, improved features that make it more simple, more flexible, more economical to install and maintain. Lighter

AN IMPORTANT *Minus* IN THE BOILER ROOM...

A VALUABLE *Plus* IN ANY PLANT...

...Less Fuel Goes In!

...MORE STEAM COMES OUT!

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

FOR PLANTS AS SMALL AS 60 H.P.

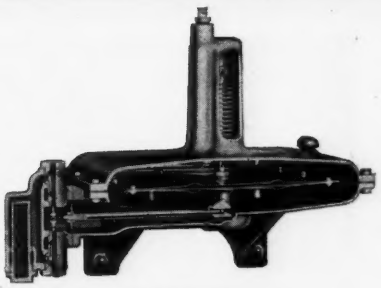
or Large as you Please

• Your present boiler is no doubt doing the best it can for you under existing conditions. Yet, there's more ability in that boiler than you think. The answer lies in CASH STANDARD Automatic Control Systems. Through this modern control of air flow — of fuel feed — of draft, your boiler will yield needed extra steaming capacity and boost operating efficiency as well.

The reason is simply in the fact that there is no wasted fuel — you burn the fuel economically. All of the fuel produces for you. Today is a most important time to make your boiler "stretch" in capacity so that your fuel supply lasts longer. An added saving is that you conserve manpower by cutting attendance time.

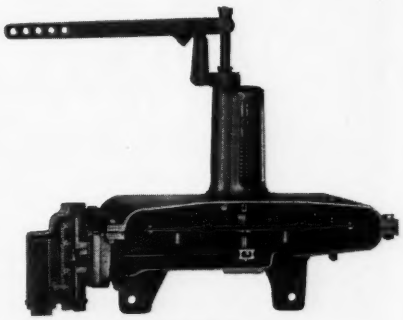
You can make a complete CASH STANDARD Automatic Combustion Control System from the units pictured and described. Through variations of these units all boiler requirements can be supplied.

Write for Bulletin No. 300 for details on this modern steam plant economy.



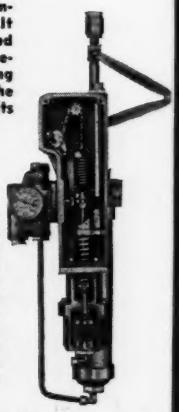
FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



AIR FLOW CONTROLLER

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion — hence, money saving.

A. W. CASH COMPANY

DECATUR, ILLINOIS

CASH STANDARD CONTROLS .. VALVES

in weight, ruggedly built for long service. All models Underwriters' Laboratories and E. T. L. Fleur-O-Lier Approved throughout.

Exclusive new-type, easy-fit wireway channel simplifies the problems of wiring and mounting for continuous rows. Units can be joined end to end in continuous rows more quickly than has been possible before. New-type wireway also permits locating ballast on "outside." This results in greater air circulation, cooler operation and longer life of ballast. Starters and sockets are also made easily accessible, without disturbing lamps. Reflectors are non-metal "Lumeni:e"—a specially-treated new composi tion—sturdy, moisture and high-heat resistant, non-corrosive. High gloss Baked Enamel finish gives high reflection factor.

The new Mitchelite fluorescent lighting is available in four models—each model so flexible it can be used for both individual and continuous row mounting . . . 2-light and 3-light units using 40-watt lamps . . . 2-light unit using 100-watt lamps . . . and a 2-section unit for four 100-watt lamps, which operates with only one ballast.

"See-Eee-Zee" Mirrorview

In numerous occasions in present-day assembly operations, machine shop work, service and maintenance, etc., it is necessary to inspect work where obstructions block the view and the only means of seeing the work is with an adjustment inspection mirror. The Blue-Point "See-Eee-Zee" Mirrorview has been designed to look at work which is otherwise inaccessible to your view.

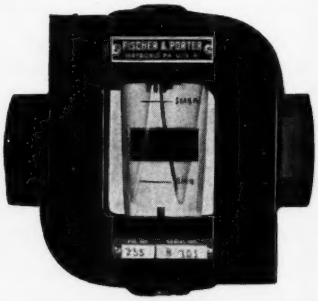
A convenient locking device operates by one hand and the mirror can be locked at any position within a 90° arc after the mirror has been inserted past obstructions.

These tools are constructed of tubing, rod, and sheet metal, zinc plated, and work freely and easily. Replacement mirrors are available and are easily inserted into the holder. Snap-on Tools Corporation, Kenosha, Wisconsin.

New Sight Flow Indicator Using Rotameter Principle

Fischer & Porter Co. announces the "ROTA-SIGHT" for flow indication in any application where an approximation of the amount of flow rate is an operating aid and necessity. This simply constructed flow indicator clearly shows when a liquid or gas is passing through a line. It has an indicating float which moves up and down in a pyrex tube in direct proportion to the amount of flow. Instantaneous response to flow change is obtained by the uniquely designed pyrex tube into which triangular V-ported flutes are formed. As a result, a variable area meter is obtained giving a wide range over a short scale length.

The metering tube is only 3" overall and the fittings are hollow so that flow may pass through them.



The "ROTA-SIGHT" may be equipped with an alarm which is a positive and inexpensive device for visible or audible protection against dangerously low or high flows. This action is accomplished by means of a magnetic float extension which trips a magnetic switch to operate the alarm circuit. High and low alarm positions are adjustable over the entire flow range of the instrument.

An interesting leaflet, Bulletin 101, explaining the "ROTA-SIGHT" in detail and giving dimensions, flow rates, and maximum operating pressures will be sent, without obligation, at your request by the Fischer & Porter Company, 959 County Line Road, Hatboro, Pa.

WILSON TUBE CLEANERS ARE BUILT TO TAKE IT

For efficient, economical and rapid tube cleaning you *must* have tube cleaners and accessories designed and built to "stand the gaff" of war time operating conditions — when tube cleaning is often put off as long as possible and then must be "rushed through" to get the boiler back on steam without delay. To do a really fast, thorough and economical job of tube cleaning under these conditions you cannot do better than buy Wilson Tube Cleaners and accessories.

Wilson Tube Cleaners have built into them the *extra power, extra speed, extra strength* and *extra efficiency* which enables them to clean straight or curved ferrous or non-ferrous tubes of large or small diameter *faster, better,* and *more economically.* Hundreds of plants producing essential war materials find Wilson Tube Cleaners and accessories invaluable aids in reducing tube cleaning time and trouble.

There is a Wilson Tube Cleaner, cutter head, brush or other accessory for *every* tube cleaning need. Write for the name of our representative nearest to you or ask for a copy of our NEW forty-page catalog which fully describes and illustrates the complete line of Wilson tube cleaning equipment.

INVEST IN AMERICA! BUY WAR BONDS AND STAMPS!

THOMAS C. WILSON, Inc.
PIPE AND TUBE CLEANERS EXCLUSIVELY
THE WILSON BUILDING
21-11 44TH AVE. LONG ISLAND CITY, N. Y.

As a part of our war effort to conserve steel and enable you to get a dust collector without a priority, the Thermix is now constructed with tubes made of tough fire clay instead of steel.

These ceramic tubes are so rugged that they will withstand temperature changes and normal handling without breakage. But should they be accidentally damaged they can be easily and quickly replaced at small cost from our large stock.

Another feature of these improved tubes is that they eliminate corrosion, reduce erosion and permit installation of the dust collector outside the plant, if desired, without any additional protecting structure.

Like the hundreds of steel Thermix Tubular Dust Collectors installed throughout the country during the past years, the Thermix CERAMIC Dust Collector assures high efficiency collection of fine dusts, powders and fly-ash.

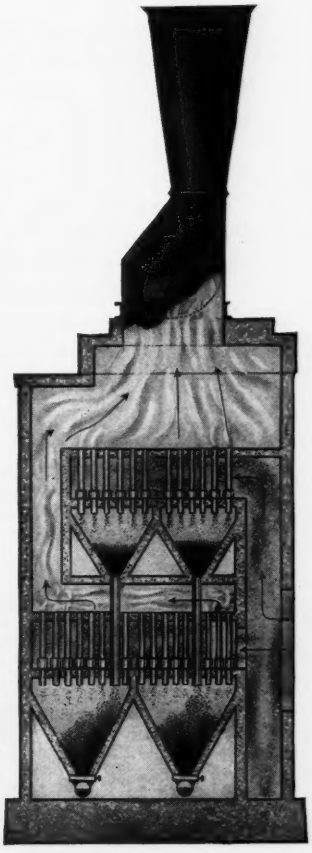
Write for Bulletin and full particulars.

PRAT-DANIEL CORPORATION, Port Chester, N. Y.

General Sales Agents

Thermix Engineering Co., Greenwich, Conn.

Representatives in Principal Cities



Thermix Ceramic DUST COLLECTOR

Voltage Stabilizer

GENERAL ELECTRIC has announced a new voltage stabilizer which provides a constant output of 115 v. from circuits varying between 95 and 130 v.

This stabilizer is insensitive to load power factor. It is not affected by variations in load from no load to full load or by changes in power factor from unity to 0.8 lagging. It is completely self-protecting, and will operate continuously throughout the range from open circuit to short circuit without damage.

The new stabilizer can be applied wherever close voltage regulation is requisite to good operation—in radio transmitters, electronic-tube apparatus, motion-picture sound equipment and projectors, telephone apparatus, X-ray machines, photo-cell equipment, and in the calibration of meters, instruments and relays. Ratings from 50 va. to 5000 va. are available.

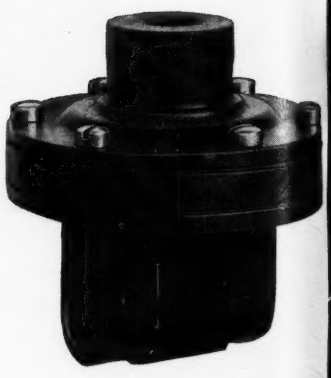
Relay Air Valve

FOR BETTER process control through faster operation of large diaphragm valve motors or of valves located at unusually long distances from controlling instruments, Taylor Instrument Companies, Rochester, N. Y., have announced as an addition to their line the Taylor Booster Relay Air Valve.

It is an auxiliary device which provides accelerated valve action to eliminate the effect of lag in large diaphragm motors and/or in long air lines between controlling instruments and diaphragm motors.

Under these conditions, the relay air valve will inflate or deflate the largest Taylor Valve Motor (diaphragm of 144 square inches), from five to seven times faster than by controller alone.

Installed in the air line adjacent to the diaphragm motor it actuates the diaphragm valve by means of an independent air supply of 25 to 150 psi. which



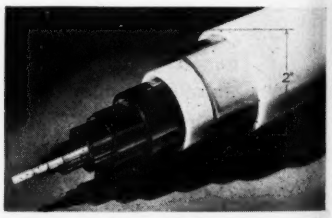
is applied or relieved through large ports. This action is in direct proportion to controller output. The ratio is 1 to 1.

Process stability is increased by causing valve action to closely follow controlling instrument output changes. Required set points can be maintained on those applications where time lags and capacities are small (rapid process reaction rates).

The booster relay air valve construction is rugged and durable. Internal assembly is corrosion-proof.

Plastic Tubing

ANNOUNCEMENT has been made by Extruded Plasties, Inc., Norwalk, Conn., that "TULOX" TT seamless plastic tubing is now available in all diameters up to 2 in., o.d., and within the next few weeks the range will be increased to 2½ in., to meet requirements of war production.



This tubing is extruded from Tennessee Eastman cellulose acetate butyrate and is available from warehouse stocks throughout the country through Crane Co., Chicago, and Julius Blum & Co., Inc., New York City.

3-Lamp Ballast for Fluorescent Lighting

THE DEVELOPMENT of a 3-lamp, 40-watt, high-power-factor ballast for fluorescent lighting of war plants has been announced by the General Electric Company.

Formerly, a 3-lamp fixture—which employs three 40-watt Mazda F lamps set side by side—required two ballasts, one Tulamp 40-watt and one single-lamp, high-power-factor 40-watt. The new 3-lamp ballast is better adapted to installation in a fixture than two separate ballasts, and the use of one ballast instead of two simplifies installation and reduces the amount of wiring required for connections.

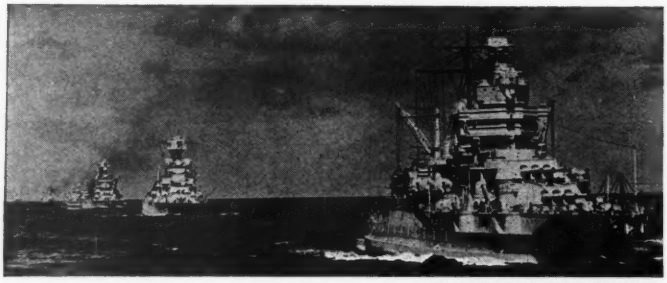


Photo: OFFICE WAR INFORMATION

Take a Good Look at these BATTLESHIPS

To any motorist with bald tires, they have a particular significance. Each one of these gigantic fighting machines requires sufficient rubber to make 17,000 automobile tires. That would keep many a motorist in tires for a long time.

Ships, Airplanes, Tanks, and numerous other fighting units required at the front, all need enormous amounts of rubber.

Quaker is playing an important part in supplying our Government with the vital rubber products and orders coming from the Government and Defense plants have the right of way. You would not want it otherwise.

Please be patient if your order with us seems a trifle long in reaching you. We are doing everything possible to spread equitably what permissible civilian Industrial Rubber Products we can manufacture.

INDUSTRIAL RUBBER PRODUCTS

Rubber is scarce, but not extinct for use in many civilian plants. It is not patriotic to allow your plant to lose production for want of Industrial Rubber Products.

The Government will permit the use of rubber products in many plants that are recognized as being on important war work. Consult Quaker whenever Industrial Rubber Products should be used. Our experience of manufacturing and knowledge of current regulations are at your service.

★ *Blast the Japs out of the Rubber Pile!*

KEEP ON BUYING MORE WAR BONDS ★

REG. U.S. PAT. OFF.

QUAKER RUBBER CORPORATION

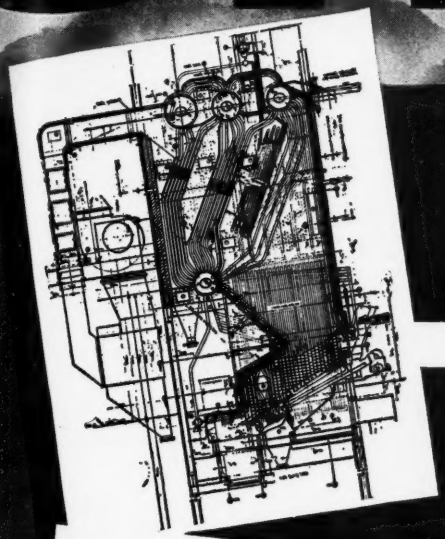
OVER 58 YEARS CONSISTENT QUALITY INDUSTRIAL RUBBER PRODUCTS

PHILADELPHIA · NEW YORK · CHICAGO · HOUSTON

Western Territory

QUAKER PACIFIC RUBBER COMPANY · SAN FRANCISCO · LOS ANGELES

STEAM *for*

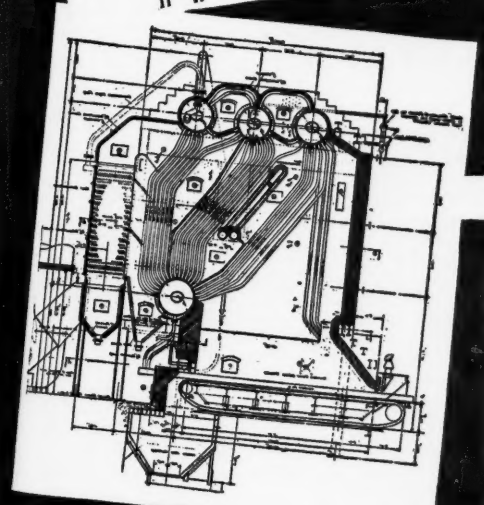


POWER

SOUTHERN COLORADO POWER COMPANY
Pueblo, Colo.

90,000 lbs. steam per hour Vogt LE type bent tube boiler with underfeed stoker. Water walls and economizer. Design pressure 525 lbs. Total steam temperature 750 degrees F.

•

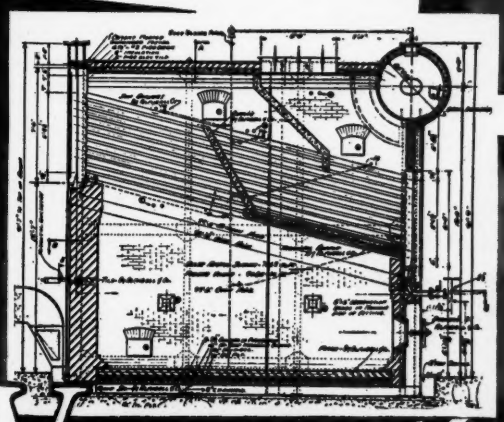


PROCESS

IN A LARGE MID-WESTERN STEEL MILL

Two 105,000 lbs. steam per hour Vogt LE type bent tube boilers with chain grate stokers and economizers. Design pressure 225 lbs. Total steam temperature 550 degrees F.

•



HEATING

CRIMINAL COURTS BUILDING AND JAIL
New York City

Four Vogt sectional header type boilers of 47,000 lbs. steam per hour capacity, oil fired. Design pressure 200 lbs.

HENRY VOGT MACHINE CO.
LOUISVILLE, KENTUCKY
Branch Offices: NEW YORK CLEVELAND CHICAGO PHILADELPHIA DALLAS

Vogt *Water Tube* BOILERS

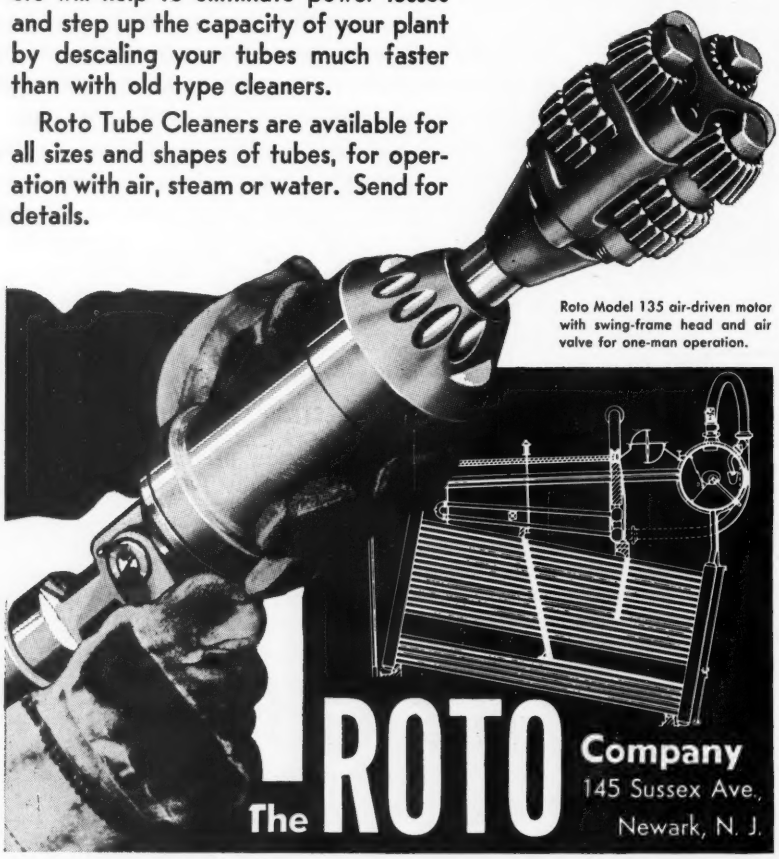
BENT TUBE AND SECTIONAL HEADER TYPES

ONE-MAN OPERATION
. . . saves time and labor with ROTO TUBE CLEANERS

No helper is needed with a Roto Tube Cleaner. One man can handle a tube cleaning job by himself with the convenient Roto Operating Air Valve on the motor.

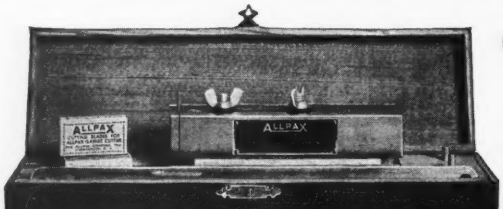
Roto one-man operated tube cleaners will help to eliminate power losses and step up the capacity of your plant by descaling your tubes much faster than with old type cleaners.

Roto Tube Cleaners are available for all sizes and shapes of tubes, for operation with air, steam or water. Send for details.



Roto Model 135 air-driven motor with swing-frame head and air valve for one-man operation.

The ROTO Company
145 Sussex Ave.,
Newark, N. J.



Cuts your gasket costs in half

The most remarkable tool ever invented

Write for booklet

THE ALLPAX GASKET CUTTER

Manufactured by
THE ALLPAX COMPANY, INC.

Distributors everywhere — *Mamaroneck, N. Y.*

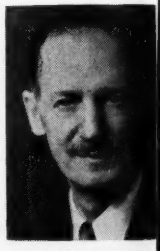
The new ballasts are designed to operate on lighting circuits of 110-125, 199-216, 220-250, and 240-280 v. Power factor is 90 per cent or above.

Heavy Duty All Steel Swivel Caster

A HEAVY DUTY all steel Swivel Caster is announced by the H. L. Pitcher Company, exclusive sales agency for the products of Rose Mfg. Co., 1240 Strathmoor, Detroit, Michigan. . . . Featured in its design are a drop forged base plate with king pin integral—around the king pin is a Timken thrust bearing—on the axle is a hardened non-turning spanner bushing and a Hyatt Roller Wheel bearing—the caster swivels on ⅜-in. chrome steel ball bearings that ride in removable (heat treated) steel races. . . . While Hyatt bearings are standard in the wheels—Oilites or any other special bearings can be furnished. This latest design makes a total of eight different types of steel casters developed by this company—their catalog shows twenty different numbers.

OBITUARIES

Arthur L. Kimball



ARTHUR LIVINGSTONE KIMBALL, research physicist and consulting engineer of the General Electric Co., died suddenly March 20 at his home in Schenectady, N. Y., of a heart attack. He was 57 years old.

Born in Baltimore, Mr. Kimball was graduated from Amherst College in 1908 and served there for the next two years as assistant in geology. In 1912 he entered Harvard engineering school, graduating in 1914 with the degree of M.E.E.

After serving two years as assistant electrical engineer for the Interborough Rapid Transit Company in New York City and instructing in mathematics at Amherst for one year, Mr. Kimball entered the employ of the General Electric Company in 1918 as engineer in the research laboratory. He held that position until 1933 when he was appointed to the staff of the engineering general department. Later he was appointed consulting engineer on the staff of H. A. Winne, vice-president in charge of apparatus design engineering.

Mr. Kimball had done considerable work on the problems of noise isolation, mechanical unbalance, and quiet fan development, building up the nucleus of the present mechanical section of the laboratory for this purpose.

He was secretary of the applied mechanics division of the A.S.M.E. from 1928 to 1930 and was chairman of that section during 1931. In 1932 his book, "Vibration Prevention in Engineering" was published, being the first of the series sponsored by the advanced course in engineering of the General Electric Company.

Famous Names
IN INDUSTRY BUSINESS AND GOVERNMENT

A REPRESENTATIVE LIST OF SATISFIED USERS OF

CANTON STOKERS

- This partial listing of satisfied CANTON STOKER users shows clearly CANTON'S adaptability to all types of fuel . . . CANTON'S useability under all operating conditions. From the largest Industrial plant to the smallest COMMERCIAL installation CANTON STOKERS have established an enviable record of service . . . a record that can be directly traced to CANTON'S 31 years experience in the manufacture of fuel burning equipment, plus an Engineering Service, which adapts each installation to suit local conditions.

In addition, because only the finest workmanship and materials are used, CANTON STOKERS are guaranteed for FIVE YEARS . . . not only against defects but WEAR as well.

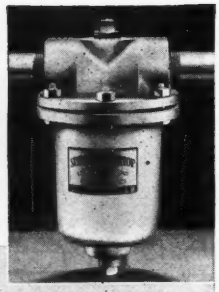
Get the full story . . . consult CANTON at once. Trained Engineers will gladly survey your plant and offer recommendations—no obligation to you. Write, wire or phone now for Descriptive Literature.

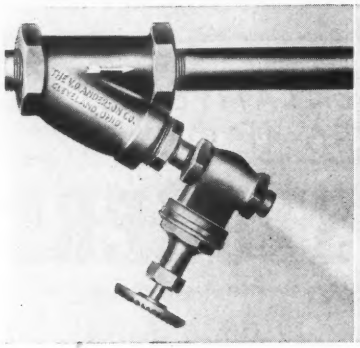
Ball Aircraft Modification Center — Niagara Falls, N. Y.
Camp Rucker — Ozark, Ala.
Richmond Air Base — Richmond, West Va.
Chicago, Rock Island & Pacific Railway — Little Rock, Ark.
Alco Fabricating Corporation — Pawtucket, R. I.
Otis Elevator Co. — Buffalo, N. Y.
U. S. Department of Agriculture — Beltsville, Md.
Topeka Air Base — Topeka, Kan.
World Bestos Corp. — Subsidiary of Firestone Tire & Rubber Co. — Paterson, N. J.
U. S. Army, Chemical Warfare Service — Columbia, Tenn.
Automatic Machine Products Co. — Attleboro, Mass.
Republic Steel Corp. (Coal Plant) — Pikeville, Ky.
Base Engineering Bldg., Fort Jackson — Fort Jackson, S. C.
Electro Metallurgical Corp. — Niagara Falls, N. Y.
Army Air Base — Virginia
Army Air Base — Tennessee
Army Air Base — South Carolina
Collier Steel Corp. — Collier, W. Va.
Southern Railway Co. — Danville, Va.
Royal Baking Co. — Raleigh, N. C.
Hospital, Army Air Base — Columbia, S. C.
Abrasive Machine Tool Co. — East Providence, R. I.
Tyler Hotel — Louisville, Ky.
John McKenzie Packing Co. — Burlington, Vt.
Single Engine Training School — Marianna, Fla.
Hospital, Fort Jackson — Fort Jackson, S. C.
Central Heating Plant — Fort Jackson, S. C.
Camp Robinson — Little Rock, Ark.
Conesta Air Base — Conesta, S. C.
District Linen Service — Washington, D. C.
Dunn Woolen Co. — Martinsburg, W. Va.
Symona Air Base — Symona, Tenn.
Power Plant — Fort Jackson, S. C.

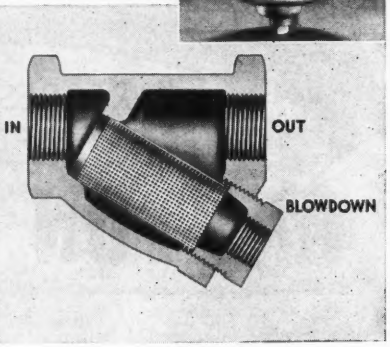
CANTON STOKER CORPORATION
ANDREW PLACE, S. W., CANTON, OHIO

The manufacturer of

SUPER-SILVERTOP STEAM TRAPS *also makes*







ANDERSON *self-cleaning* STRAINERS

ANDERSON improved strainers with their stainless steel elements remove scale, grit and sediment from the steam line.

This strainer cleans itself when a blowdown valve is used or when the pipe plug is removed. It's easy to install and inexpensive so that one can be used on every piece of equipment—pressure regulating valves and metering devices, liquid and gas lines, steam traps and air tools, spray heads and oil burners, solvent stills and temperature regulating valves. Write for "How To Choose A Steam Trap" which gives complete specifications.

THE V. D. ANDERSON COMPANY

1939 West 96th Street • Cleveland, Ohio

OUR MEN NEED ★ BOOKS ★

SEND ALL YOU CAN SPARE

That book you've enjoyed—pass it along to a man in uniform. Leave it at the nearest collection center or public library for the 1943 VICTORY BOOK CAMPAIGN.

He was a fellow of the American Physical Society and of the American Acoustical Society, and was a member of the American Meteorological Society and the American Society of Mechanical Engineers.

George E. Deming

GEORGE E. DEMING, vice president and secretary of the Philco Corporation, died at his home, Pine Road near Bryn Athyn, Pa., April 15, 1943, of a heart attack after a brief illness. He was 55 years of age.

Born in Philadelphia in 1888, Mr. Deming attended night school at Drexel Institute. He was graduated in electrical engineering in 1912 from University of Pennsylvania.

In 1917 Mr. Deming joined Philco, then a small storage battery manufacturing company, as assistant superintendent of the factory. He immediately began to take a leading part in the management and direction of the company and he became successively superintendent of the factory, executive vice president, vice president in charge of production, and in 1941 was named vice president and secretary.

Mr. Deming took a leading part in civic affairs and welfare activities in Philadelphia. He was a member of the board of trustees and vice president of the Methodist Hospital, Philadelphia. He was past president of the Engineering Alumni Society of the University of Pennsylvania, and active in the Red Cross, the United War Chest, the Y.M.C.A. and United China Relief.

James T. Machen

JAMES T. MACHEN, assistant vice president of the Ric-Wil Co., Cleveland, Ohio, died as the result of a heart attack while conducting a sales meeting at the company's office on March 31.

Mr. Machen who was 34 years old had been associated with the Ric-Wil Co. for the past 14 years. His mother and two sisters survive. Burial was in Laurens, South Carolina.

MANUFACTURERS' NEWS

Army-Navy "E" Awards

Foote Bros. Gear and Machine Corp.
Chicago, Ill.
Johns-Manville,
Manville, N. J.
Elliott Co.,
Ridgeway, Pa.
Erie Works, General Electric Co.
Midwest Piping and Supply Co.
St. Louis, Mo.
LaPlant-Choate Mfg. Co.
Cedar Rapids, Ia.
Foster Wheeler Corp.*
Dansville, N. Y.
Manning, Maxwell & Moore, Inc.
Boston and Bridgeport Plants.

*Fourth Award.

Eliminate Air . . .
Cut Corrosion . . . Stop Leaks
. . . Use FLOWRITES . . .
Shock-Test . . . Stretch . . . Save the
Tubes You've Got

In holding down condenser maintenance costs, the Big League Utilities have kept our facilities and our field crews busy for seventeen years.

Costs are now secondary. To keep power always available to war production with the least tonnage of copper, find out about Conseco nation-wide, clock-around service.

AIR AND EROSION ELIMINATORS

These removable screen plates, fitted with air ejection piping, remove air from circulating water before it attacks tube sheets and tube ends. Increase tube life from three to seven times, in the average installation.

SHOCK TEST

The 10-year-old hydrodynamic Shock Test destroys tubes just ready to fail. Frequently, less than ten per cent of the tubes in large condensers require replacement, but only by shock-testing can you know good tubes from bad.

STRETCH WORN TUBES

Even a tube with the ends worn through can be salvaged. Let us, by shock-test, eliminate every tube incapable of further service, stretch the usable tubes, cut off the bad ends and return the useful lengths to service.

"CONDENSER SERVICE"

FLOWRITES

Replaceable, bell-mouthed FLOWRITES provide smooth, directed flow of circulating water, preventing gas-caused erosion of tube ends.

"WIZARD" INJECTORS

Open a pair of valves to the steam line, inject "Wizard" Leak Compound. Stops tube leaks within seconds.

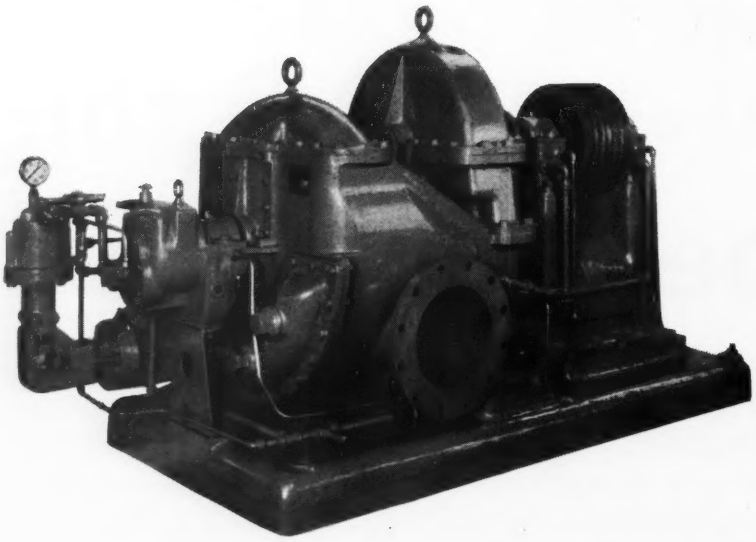
A letter, telegram or 'phone call will start your job rolling. Estimates furnished for specific work.

CONDENSER SERVICE & ENGINEERING CO., INC.

SEABOARD BANK BUILDING — HOBOKEN, NEW JERSEY

MURRAY TYPE UG

Integral Geared Turbine



★ **Murray Type "UG" Integral Geared Turbine consists of the Type "U" Mechanical Drive Turbine with integral single or double helical reduction gear. Turbine is supported by the gear at the turbine shaft centerline thereby avoiding misalignment due to the heating of the turbine casing.**

View shows Murray unit equipped with variable speed direct acting oil pump governor, and extended low speed shaft with sheave for V-belt drive. Write for descriptive bulletin.

BOILERS TURBINES ENGINES

MURRAY
IRON WORKS COMPANY
INCORPORATED 1870
BURLINGTON IOWA

CHANGE OF ADDRESS

To avoid missing an issue or paying for forwarding postage be sure to send a change of address to our office. Changes received by the 20th of the month can be made effective for following month's issue.

POWER PLANT ENGINEERING

NEWS FROM THE FIELD

Westinghouse Orders Up 85 Per Cent

REFLECTING industry's accelerated production task during the first year of war, the Westinghouse Electric & Mfg. Co. recently reported its orders received in 1942 showed an 85 per cent increase over 1941. The 1942 orders amounted to $1,079,636,268.

The company's 57th annual report also disclosed that billings in 1942 amounted to $487,274,551, an increase of 32 per cent over 1941. Unfilled orders, December 31, 1942, totaled $925,449,652, compared with $419,550 654 at the end of 1941, an increase of 121 per cent.

Net income for 1942 was $17,366,841, a decrease of 25 per cent from the company's net income of $23,117,510. The Westinghouse tax bill in 1942 was $71,446,548, compared with $61,537,295 in 1941. The number of employes reached 97,423 at the end of last year, with a payroll for the year amounting to $239,634,071.

The year's work surpassed anything that the company had ever experienced, or even expected to experience.

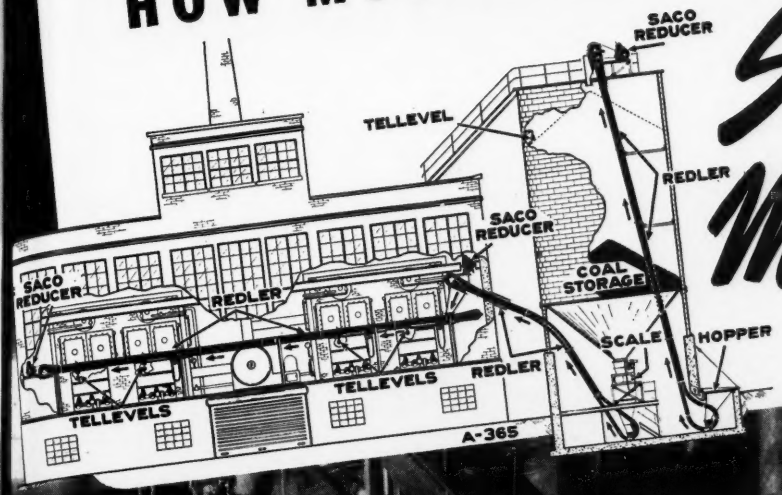
During the year there has been a marked increase not only in total production, but also in output per employe. The organization was considerably benefited by labor-management committees that were set

G.E's. 1942 Orders Over Two Billion Dollars

AS REPORTED in the 51st Annual Report recently issued by the General Electric Co. orders received by the General Electric Co. during 1942 amounted to $2,003,039,023, which was 77 per cent greater than the record total booked in 1941. The amount of unfilled orders on hand plus assured business pending at the close of the year was approximately equal to 15 months' output at current production rates and prices. In this connection the report points out that during the past two years the company has utilized the services of some 1400 other companies in 32 states on sub-contracts involving over $250,000,000 for work it would ordinarily perform in its own plants located in 21 states. In these cases it has furnished designs and experience, and has assumed responsibility for the work performed.

Shipments during 1942 of $1,047,134,843, also previously announced, were 54 per cent greater than in 1941 and more than three times the average for the five years ending with 1940. Many war contracts undertaken by the company involved products with which it had had little or no previous manufacturing experience, or for which engineering designs had not been completed, and in such cases initial contract prices were established on the basis of estimated costs. Substantial savings were effected as production increased, and General Electric adopted the policy of reviewing completed and partially completed war contracts in order to offer price reductions to the Government. By the end of 1942, this

HOW MODERN COAL FIRING *Saves Manpower*



Stephens-Adamson REDLER Conveyors

• Modern methods of coal handling—from car to boiler—make solid fuel as practical and convenient as other forms.

As shown above S-A Redler Conveyor-Elevator installations are almost as simple as stringing a wire—and coal flows through their compact dust-tight casings just about as smoothly and efficiently. There are no complicated accessories—just casings, skeleton conveying element and low speed drive mechanism. (Notice the S-A Saco Reducers as used above.)

S-A offers you *all* designs of coal and ash handling equipment and systems, including standard Belt Conveyors and Bucket Elevators—Pivoted Bucket or Gravity Discharge Conveyors—as well as the patented Redler Conveyor-Elevator. Our engineers will, without obligation, be glad to consult with you at your convenience.

WRITE US

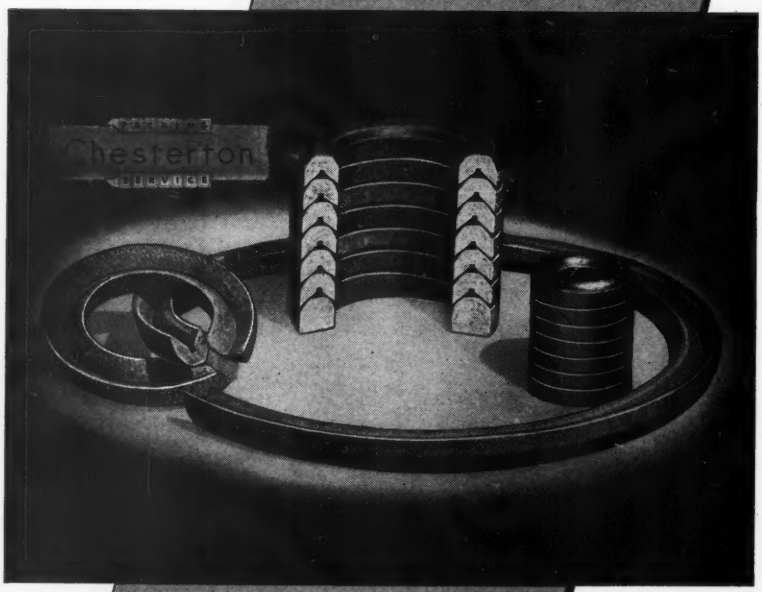
STEPHEN S-A ADAMSON MFG. CO.

Chains and Sprockets · Belt Conveyors · Bucket Elevators · Crushers
Bin Gates · Pan Conveyors · SealMaster · Feeders · Screens
Speed Reducers · Redler Conveyors · Ball Bearings · Skip-Hoists · Winches and Car Pullers

5 Ridgeway Avenue, Aurora, Illinois

MODERN PATH TO PACKING SATISFACTION—

FULLY AUTOMATIC
•
MOLDED IN CONSTRUCTION
•
ONE PIECE—NOT LAMINATED



NO BACKING-OFF GLAND
•
BOTTOM RING CANNOT TWIST
•
KEEPS TIGHT SEAL
•
SAVES ON MAINTENANCE

★ Sold in all principal cities by Factory-Trained Distributors. Write today for descriptive Catalog 20-E.

A. W. CHESTERTON CO.
64 India St
BOSTON, MASS.

CHESTERTON
Parachute Packing

WHEN YOU WRITE TO ADVERTISERS

When writing advertisers for catalogs, descriptive bulletins or prices, please remember to say, "I saw your message in POWER PLANT ENGINEERING." Thus you'll do a good turn for the advertiser and for this publication. . . .

policy had resulted in offers to reduce the aggregate price of 119 war contracts by $95,053,000, and additional offers are under consideration. Of this total, the amount applicable to 1942 shipments was $69,360,217.

The disposition of a dollar of the company's total income from all sources, in 1942, resulted in 39 cents being paid as earnings to employees (compared with 36 cents in 1940); 31 cents for materials, goods, and services purchased from others (compared with 35 cents in 1940); 23 cents for federal, state, and local taxes payable (compared with 13 cents in 1940); two cents for depreciation; and five cents (compared with 13 cents in 1940) as dividends to stockholders or for reinvestment in the business.

Total cash and marketable securities held by General Electric at the close of 1942 amounted to $105,566,057 compared with $98,723,044 on December 31, 1941. The company also held U. S. Treasury notes for tax payments of $106,000,000. Accrued federal taxes on income for the year were $193,000,000. The increase in cash and marketable securities and other current assets was almost entirely offset by the increase in current liabilities, which totaled $310,861,494 at the close of 1942 compared with $180,659,497 at the close of 1941.

General Electric stockholders on December 31 totaled 221,608, an all-time record.

The cost of plant and equipment at the end of 1942 was upwards of $267,000,000, carried at a net book value of $66,767,673. Plant and equipment added during 1942 by General Electric amounted to $29,488,393.

Crane Personnel Changes

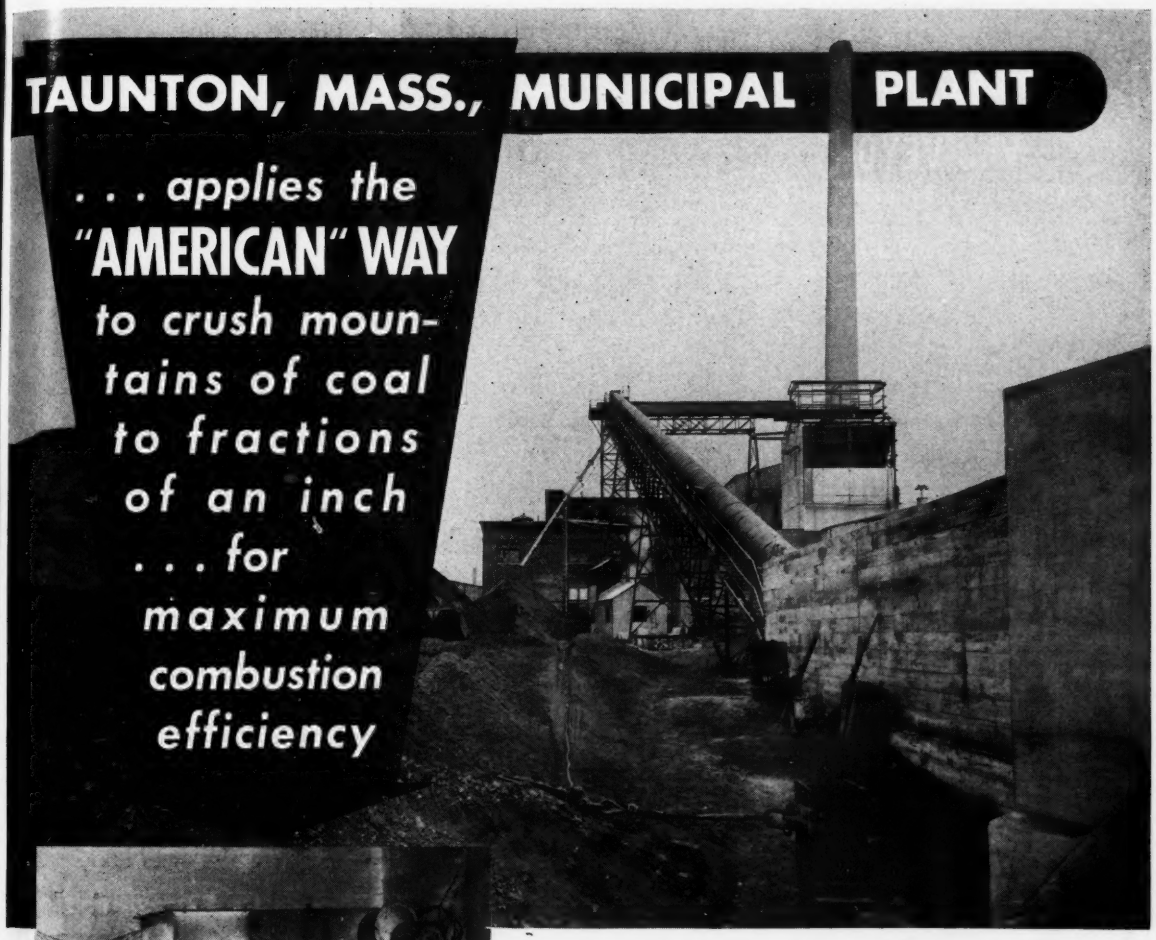
Crane Co. announces that Harry F. Potter has been elected secretary of the company. His 43 yr. of service cover a wide variety of positions in the finance, credit, operating and sales departments of both the parent company and the Canadian subsidiary. Since 1931 he has been manager of branch houses, and is succeeded by James A. Dwyer, manager of District No. 1 with headquarters in the New York branch. In his new position, Mr. Dwyer will be assisted by A. H. Prasse.

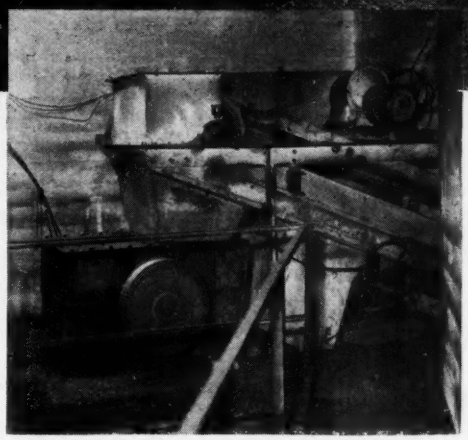
David J. Molloy, assistant manager of the New York branch, succeeds Mr. Dwyer as district manager, and he in turn is followed by George P. Gregory, Jr., as assistant to the manager of the New York branch.

V. W. Farris announces the formation of the Ferris Engineering Co. with a new plant at Ridgefield, N. J., devoted to the manufacture of pressure reducing valves, valves for high pressures and temperatures for salt and fresh water service and custom built constructions for difficult services. Strainers in the Y type, Macomb, as well as welded constructions are being offered. Steam separators, special filtering devices also represent part of the manufacture. The new company is now manufacturing equipment for the Navy, Maritime Commission, and other groups assisting in the war effort. Also operating is the Farris Engineering Corporation which is a separate group under the same management handling consulting engineering, design and development of new products

TAUNTON, MASS., MUNICIPAL PLANT

. . . applies the "AMERICAN" WAY to crush mountains of coal to fractions of an inch . . . for maximum combustion efficiency





HOW THE "AMERICAN" ASSURES PROPER SIZING

Manganese steel shredder rings are an exclusive feature of the "AMERICAN" Crusher. These rings are designed in such a way that coal is split rather than crushed thereby assuring exact sizing.

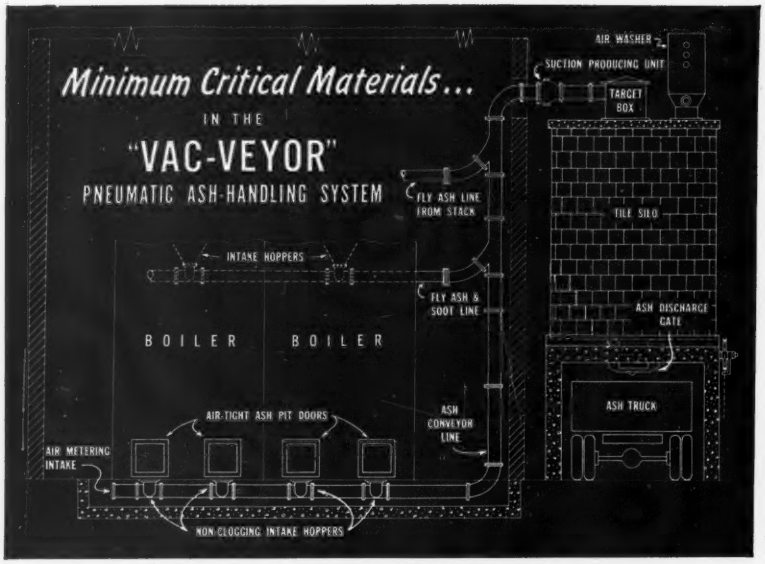
Proper coal preparation—for stoker or pulverized fuel firing—is an important consideration today as a means of getting the most out of every ton of coal you burn for power. Furthermore, proper coal preparation contributes to the realization of uninterrupted plant operation which is so necessary to meet the "all-out" demands for power.

Appreciation of the importance of these and other objectives led the engineers in charge of the Taunton, Mass., Municipal Power Plant to install an "American" Ring Crusher to size their coal. Some idea of the tonnage of coal handled by this "American" is obvious from the photograph of the coal storage and handling facilities shown here. The "AMERICAN" Ring Crusher — sturdy and designed for tough service — has ample capacity to meet the demands made upon it.

A check up on costs would undoubtedly show a crushing cost of less than a cent per ton which is an average figure for "AMERICANS" based on performance in many plants.

Now is the time for you to investigate the possibilities offered by "AMERICAN" Ring Crushers. Send at once for Bulletin "Crushing Coal at Less Than One Cent Per Ton." FREE ON REQUEST.

AMERICAN PULVERIZER COMPANY
1429 Macklind Avenue
St. Louis, Missouri
ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS



Write us today for complete details

Designed to fill today's needs in either new installations or oil-coal conversion, this pneumatic ash handling system offers numerous advantages.

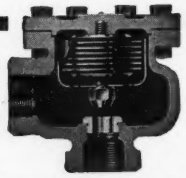
BEAUMONT BIRCH COMPANY
1505 RACE STREET PHILADELPHIA, PA.

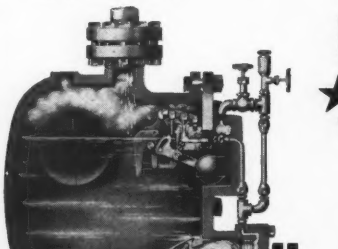
MANUFACTURERS AND ERECTORS OF COMPLETE COAL AND ASH HANDLING SYSTEMS

It Takes a Trap with Guts to Stand the Gaff of America's Round-the-Clock War Production

Nicholson Thermostatic Type Industrial Traps Provide Large Capacity . . . Long Life . . . 100% Efficiency.

Sizes ¼" to 2" . . . Pressures from vacuum to 300 lbs. . . . types for all applications.





★ **SPECIALLY DESIGNED TRAPS FOR SUPERHEATED STEAM SERVICE**

For dependable efficiency and economical durability, Nicholson makes a complete line of high pressure traps. Weight Operated for pressures to 1500 lbs.—Piston Operated for pressures to 650 lbs. Several models, various constructions, numerous sizes—for all purposes.

CATALOG No. 941—W. H. NICHOLSON & CO., 160 OREGON ST., WILKES-BARRE, PA.

NICHOLSON *Traps*

THERMOSTATIC ▼ PISTON AND WEIGHT-OPERATED STEAM GASOLINE AND COMPRESSED AIR TRAPS ▼▼▼

CONTROL VALVES ▼ FLOATS ▼ MANDRELS ▼ STEAM AND AIR SEPARATORS

and serves as a patent holding and licensing organization.

The Valve Division of the Clayton Manufacturing Co., Alhambra, Calif., has recently added H. E. Goss to its sales promotion staff. Mr. Goss is a native of Portland, Ore., and began his business career with the Crane Co. in that city and in 1922 opened a branch for Crane in Pasadena. He remained with Crane Co. in various managerial positions in offices throughout the west until he took his present position with Clayton Manufacturing Co.

Bantam Bearings Corp., South Bend, Ind., a subsidiary of The Torrington Co., of Torrington, Conn., for the past eight years, has been merged with its parent company and will henceforth be known as The Torrington Co., Bantam Bearings Division. The Bantam Division will retain its present personnel and continue its operations from the South Bend headquarters. The merger makes available to industry, from a single company an unusually diversified line of anti-friction bearings. Bantam produces all of the major types with special emphasis on custom-built bearings in the larger sizes up to 12 ft. in diameter. In addition, the combined facilities of Bantam and Torrington provide the manufacture of a complete range of needle bearings from a unified source.

Diesel Engineers to Discuss Wartime Problems at Baltimore Meeting

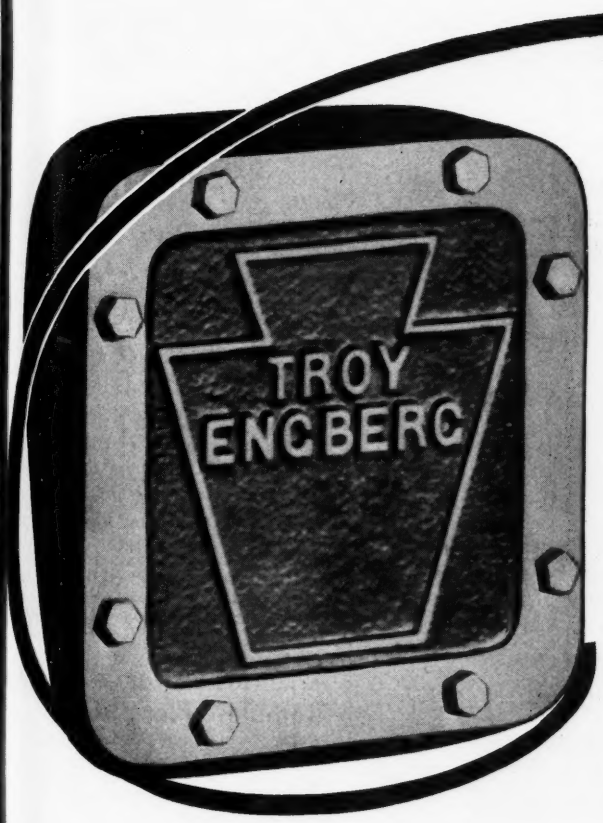
THE 16TH National Oil & Gas Power Conference to be held June 14-16 at the Lord Baltimore, Hotel, Baltimore, Md., will emphasize, in technical sessions and inspection trips, the naval applications of diesel engines.

Maintenance of diesel engines in naval service will be the theme of one technical session while another will deal with new developments of chromeplating for cylinder liners and piston rings that promise to increase service life. Highlight of another session will be a discussion on the present position and future prospects of diesel fuels—a subject of extreme timeliness and importance. Other papers will cover the application of the new internal-combustion-engine test code, investigation of large diesel-engine wristpins, methods of calculating stresses in connecting rods, and the newly developed supersonic reflectoscope for inspecting materials.

If wartime restrictions permit, inspection trips will be made to the Naval Experiment Station at Annapolis, with its world-famous diesel-engine laboratories, and to the American Hammered Piston Ring plant, making rings for everything from aircraft engines to the 70-in. dia. low-pressure pistons of Liberty ships.

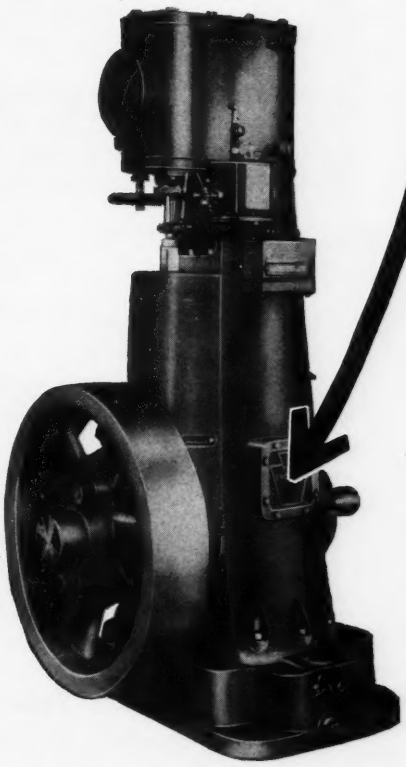
Admiral Mills, in charge of the engine division of the Bureau of Ships, has been invited to speak at the banquet, on the general subject of rating diesel engines for naval service.

At the exhibit, an annual feature, leading manufacturers have arranged to display the latest in engines and accessory equipment.



The Name-plate
On Thousands of

LOW COST POWER UNITS



Yes, it's the dependable modern steam engine which when plant heat balance conditions are suitable will deliver power for driving equipment at a lower cost than can any other power unit. Costs are frequently low enough so that the savings pay for the engine within a year. And coupled with the lower power cost are drive characteristics very desirable for certain kinds of equipment . . . wide speed range and great flexibility; easily controlled automatically; high starting torque and ability to handle sustained overloads for long periods; freedom from fire hazard.

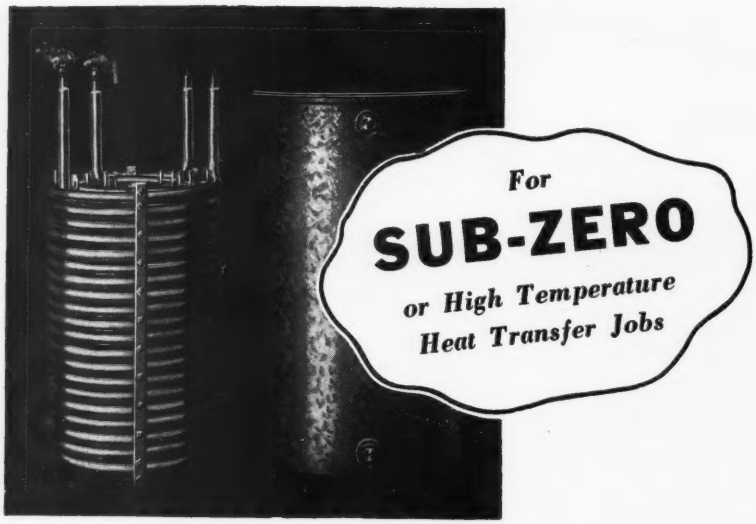
The modern steam engine offers so much as a low cost and otherwise desirable drive that its use should be considered *now* as a replacement for war plant drives now showing signs of wear. With a high priority we can probably take care of you. So, why not look into the matter? Plan now, also, for your post-war plant setup.

TROY ENGINE & MACHINE CO.

Established 1870

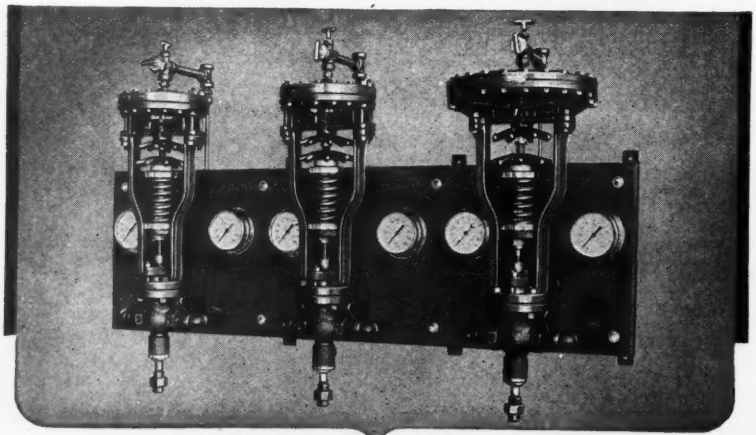
852 Railroad Ave. **Troy, Pa.**

5-TEM-1



Rempe Shell and Coil units are suitable for liquid cooling to as low as 40 degrees below zero or liquid heating to elevated temperatures. They are individually designed for specific capacity requirements. Write for estimates.

REMPE CO.
342 No. Sacramento Blvd., Chicago



There's a Solution **to Your Toughest Pressure Control Problems with SWARTWOUT REGULATORS**

YOUR IDEAS about *what* you want to accomplish in power control probably are perfectly clear. It's the *how* that is often the problem. That's where Swartwout can help you with suggestions gained in wide experience • As an example, the three Swartwout Type "CPM" Master Regulators above operate a 4" control valve in a three-way hook-up that (1) maintains a definite low pressure; (2) "unloads" if pressure exceeds a fixed point; (3) prevents pulling high side down too low • Swartwout gladly discusses your needs with you or your consulting engineers.

THE SWARTWOUT COMPANY • 18511 Euclid Ave. Cleveland, O.

Swartwout

Northern States Power Begins Power Plant Construction

THE NORTHERN STATES POWER C Minneapolis, Minn., has begun m sonry superstructure for proposed a dition to High Bridge steam-elect generating station on Mississi River, St. Paul, Minn., for which pla have been in progress for a number months past. New structure will about 90x150 ft., and approximat 140 ft. high, steel frame, concrete a masonry type. Installation will i clude a new 50,000-kw. turbine-gen ator unit and complete accessori with expansion in switchyard and fi facilities. It is estimated to cost abo $5,000,000. A priority rating has be secured and erection will be push to completion at earliest date. Gene contract for erection has been award to F. J. Romer Construction Co., Ramsey St., St. Paul; and award f heating and plumbing has been ma to George H. Westman, 1179 Jes St., St. Paul. Contracts for other fe tures of work are scheduled to be at early date. Public Utility Engine ing & Service Corp., 231 South L Salle St., Chicago, Ill., is consulti engineer.

Arkansas Power & Light to Complete Plant Soon

THE ARKANSAS POWER & LIGHT C Pine Bluff, Ark., has active constru tion under way on new outdoor-ty steam-electric generating station in cinity of Stamps, Ark., on which wo was begun a number of months a Various contracts have been let f erection and equipment. The Co struction Engineering Co., Pine Blu has award for installation of boile and certain other equipment; Foste Wheeler Corp., New York, N. Y., furnishing a cooling tower; and Bla Knox Co., Pittsburgh, Pa., has co tract for piping installation, includi high-pressure steam lines, boiler fe piping and water lines; Chicago Brid & Iron Co., Chicago, Ill., has co pleted construction of a new 50,0 gal. elevated water tank near the st tion. Plant will use desulphurized g for fuel, to be secured from the M Kamie gas field, Lafayette Coun Ark., under contract with the M Kamie Gas Cleaning Co., McKamie, joint subsidiary of the Atlantic R fining Co., Philadelphia, Pa., and C ter Oil Co., Tulsa, Okla., which h constructed a special treatment pla for "sour" gas for this service. A co tract has recently been awarded t Arkansas company to Pioneer Co struction Co., Malvern, Ark., for clea ing right-of-way from new generati station to gas field for installation of 6-in. pressure pipe line for gas trans mission, and work is now in progres Same contracting company also h secured award for clearing a right-o way for new 110,000-volt transmissi line from generating station to a poi near Magnolia, Ark., where a pow substation and switching station w be located, connecting with main high tension system of company. Pipe lin and transmission lines are estimated t cost about $150,000. Entire project wi represent an investment of approx mately $3,000,000. It is expected t have the plant in operation at ear date.

THE ALDRICH-GROFF CONTROLLABLE CAPACITY "POWR-SAVR" PUMP . . .

. . . for MAIN BOILER FEED and DESUPERHEATING SERVICE

Aldrich-Groff Pumps provide for automatic or remote manual control of delivery, from zero to full capacity, at constant pump speed. Rate of delivery is controlled by varying the length of the plunger stroke, and power consumption is almost directly proportional to pump delivery. These pumps combine the positive displacement and high efficiency of the plunger type pump with the flexibility and smoothness of a centrifugal.

The use of these pumps with unit feed systems eliminates the pressure and power losses associated with throttling-type feed-regulating valves. They provide advantages of feed system simplicity, efficiency and mechanical reliability for the small and medium boiler plant using medium and high steam pressures, and for de-superheater feed service in even the largest power stations. Over 100 units in operation on land and sea with outstanding service records.

Write today for the Aldrich Bulletin 65. It gives full details, sizes and ratings of Aldrich-Groff "Powr-Savr" Pumps.

THE ALDRICH PUMP CO. ALLENTOWN, PENNA.

DO YOUR RECIPROCATING PUMPS RACE ALL DAY?

SLOW 'EM DOWN
SAVE STEAM WITH **COMBINATION**
NON-TILT, NON-SLIP VALVES

**For Boiler Feed
Vacuum, Condenser
General Service**

THE tilting action of some reciprocating pump valves permits the seat to wear unevenly—means the pump has to operate faster and waste steam to carry its theoretical load.

COMBINATION Pump Valves slow down and help save steam because they are built especially to prevent tilting and consequent slippage. Seat, stud and spring are made of long-lasting Phosphor Bronze. They match the fine performance of COMBINATION Silent Check Valves. Ask for descriptive folder with dimensions, prices and further details.

COMBINATION PUMP VALVE CO.
846 Wiota Street, Philadelphia, Pa.

UNRETOUCHED PHOTOGRAPH OF

SCALE DEPOSIT
IN 12-INCH STEAM LINE

The picture of this scale deposit was taken from a point in the header 400 feet from the boilers. This scale seriously impaired the efficiency of this plant.

The solution to this problem is Haering Glucosates which remove the scale and protect pipe lines from further scale and corrosion.

D. W. HAERING & CO., Inc.
GENERAL OFFICES:
205 West Wacker Drive
CHICAGO, ILLINOIS

SEND FOR INFORMATION

D. W. Haering & Co., Inc.
205 Wacker Drive, Chicago.

Please send me information on Steam Treatment. (P.P.E.)

Name .....

Address .....

City..... State.....

Robins Announces Change of Name

ROBINS CONVEYING BELT CO., Passai N. J., designers, manufacturers an erectors of materials handling machi ery announces that it is shortening i name to Robins Conveyors Incorpo ated. The new name more truly desi nates its products. Thomas Matche President of the corporation, said t change of management, personnel corporate structure is involved in th change, which is one of name only.

The organization of an Anthraci Section in the Stoker Manufacture Association was officially completed a meeting of anthracite stoker man facturers in New York City late la week.

Executives in attendance at t meeting represented practically a manufacturers of hard coal burner and elected Milton A. Young, Catski New York, as Chairman of the An thracite Section. Mr. Young is Sal Manager of the Catskill Metal Work Inc.

Three standing committees wer named to handle problems and subject dealing with anthracite stoker equip ment. Frederick Kalmbach, Presiden General Machine Co., Emmaus, Pen sylvania, was appointed chairman of Development Committee; Harold Cooper, Cooper & Cooper, Inc., Pitt field, Massachusetts, will act as chai man of the Trade Relations Commit tee; and Adair Rogers, Presiden Stewart-Rogers, Inc., Philadelphi Pennsylvania, was named as chairma of the Engineering Committee.

The seventeenth semi-annual meet ing of the Eastern Photoelasticity Co ference and Symposium on Extern Stress Analysis will be held May 1 14 and 15 at the Rackham Memori Bldg., Detroit, Mich. Arrangement are in charge of the Chrysler Insti tute of Engineering, Highland Par Mich.

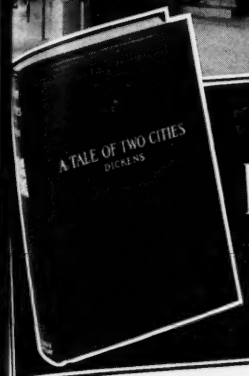
AT THE FIRST meeting of the new elected board of directors of Stewart Warner Corporation, Albert R. Benson assistant secretary and assistant treas urer, was elected corporation secretary He replaces Lynn A. Williams, Jr., wh continues as vice-president. All othe corporation officers were re-elected.

Joining Stewart-Warner Corporatio in 1930 as private secretary to a cor poration official, Mr. Benson rose t an executive position. In 1934 he wa appointed assistant secretary and as sistant treasurer.

American Standards Assn. has an nounced the election of four new mem bers to its Board of Directors. The new board members took office Janu ary 1, 1943, and will serve for three years. They are:

J. T. Barron, Vice-President, Pub lic Service Electric and Gas Company Newark, New Jersey, nominated by the American Institute of Electrical Engineers; C. A. Gill, Vice-President Reading Company, Philadelphia, Pa. nominated by the Association of American Railroads: Robert G. Gris wold, President, Electric Advisers Inc., New York, nominated by the American Gas Association; Alvah Small, President, Underwriters' Lab oratories, Inc., Chicago, Illinois, nom inated by the National Safety Council

Single Cylinder Horizontal "Universal Unaflow"



A Power Tale of Four Cities

IN these widely separated cities Skinner "Universal Unaflow" Steam Engines are making sizable savings in power costs. Electricity is being generated at a much lower cost than if it were purchased from the local utility companies. Exhaust steam is used for space heating or process purposes.

These are not unusual cases. In practically every known industry similar savings are being effected where far-sighted management is using Skinner engine-generating equipment. Although you may have a seemingly low *rate per kilowatt-hour* for purchased power, it will pay you to investigate, for postwar planning, how much lower your *cost* could be for power generated by Skinner "Universal Unaflow" Steam Engines.

At present we are engaged entirely in building engines for the War Program, but our engineers are always available to discuss planning for the future. Case studies pertaining to your particular industry will be sent upon request.

BUY MORE WAR BONDS

HOSPITAL

Modern metropolitan hospital in Pittsburgh, Pa. Electric power generated by three horizontal "UNIVERSAL UNAFLOW" Steam Engines driving 3-wire D-C generators, of 700 kw. total capacity. Steam pressure 150 psi., sat.; back pressure 1-5 psi. Installed in 1931.

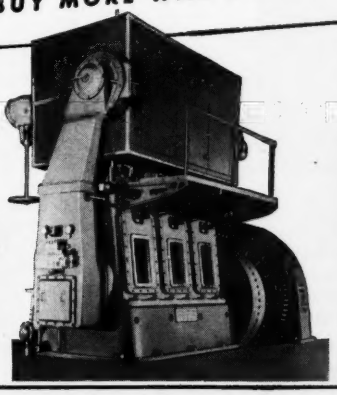
TEXTILE PLANT

Typical New England woolen mill in Rockville, Conn. Main generating unit is horizontal "UNIVERSAL UNAFLOW" Steam Engine and 625-kva. 2-ph. 60-cy. 480-volt A-C generator, V-belted exciter. Steam pressure 135psi., sat.; back pressure 0-7 psi. Installed in 1941.
(This company has four additional "UNIVERSAL UNAFLOW" engines in other plants.)

HOTEL

Prominent 1000-room hotel in Columbus, Ohio. Power requirements of hotel and adjoining office building generated by three multi-cylinder vertical "UNIVERSAL UNAFLOW" Steam Engines with 250-volt D-C generators. Total capacity 1400 kw. Steam pressure 150 psi., sat.; back pressure 0-5 psi.
Installed in 1930.

Multi-Cylinder Vertical "Universal Unaflow"



ARMY (E) NAVY

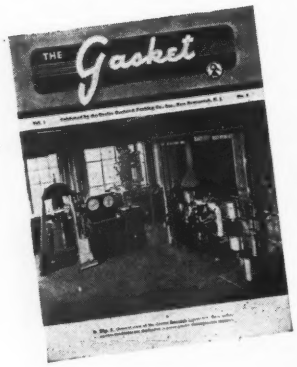
Proudly we fly the Army–Navy "E" Flag, awarded for excellence in production

PRINTING PLANT

Large Chicago printing plant (partial view) making its power with three 250-volt D-C generators driven by horizontal "UNIVERSAL UNAFLOW" Steam Engines, 1000 kw. total. Steam pressure 140 psi., sat.; back pressure 1 psi. First unit installed 1926.

SKINNER ENGINE COMPANY FOUNDED IN 1868 **ERIE, PA.**

GASKET RESEARCH
Offered in Series of Technical Bulletins



Goetze Gasket Research has developed hitherto unknown gasket data through the duplication of actual service conditions in their modern laboratory.

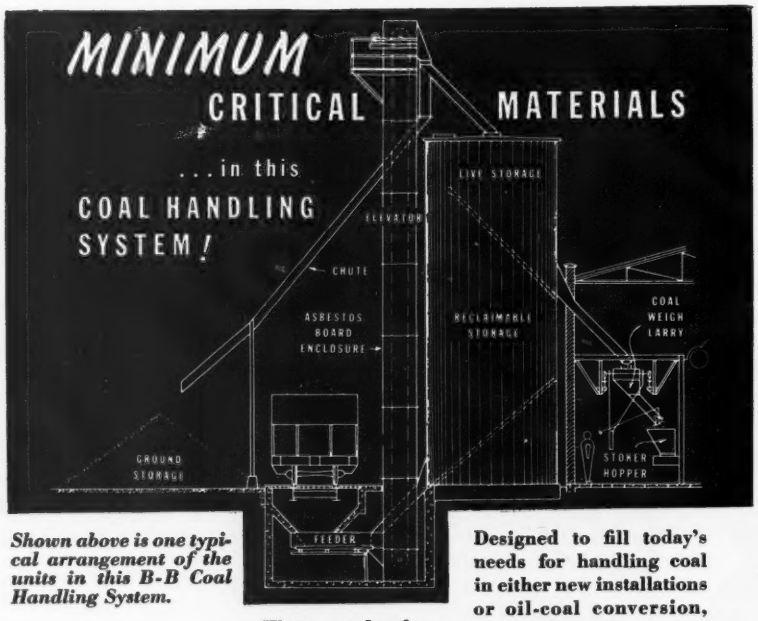
This information is being issued in a series of technical bulletins available to interested engineers and designers of pressure equipment.

If you wish to receive these bulletins regularly, write on your company letterhead, giving your position.

GOETZE GASKET & PACKING CO., Inc.
65 Allen Ave., New Brunswick, N.J.

Goetze for GASKETS
"America's Oldest and Largest Industrial Gasket Manufacturer"

MINIMUM CRITICAL MATERIALS
...in this COAL HANDLING SYSTEM!



Shown above is one typical arrangement of the units in this B-B Coal Handling System.

Write us today for complete details.

Designed to fill today's needs for handling coal in either new installations or oil-coal conversion, this system offers numerous advantages. Send for full information.

BEAUMONT BIRCH COMPANY
1505 RACE STREET PHILADELPHIA, PA.

MANUFACTURERS AND ERECTORS OF COMPLETE COAL AND ASH HANDLING SYSTEMS

MANUFACTURERS' PERSONALS

Three changes announced from General Electric's Pittsfield Works include the appointment of M. I. Alimansky as engineer in charge of the capacitor section; Charles F. Miller as manager of capacitor sales; and Fred G. Stebbins as assistant manager of sales of the distribution transformer and feeder regulator section.

Mr. Alimansky, who has managed capacitor sales for the past year, is a native of Boston and entered the employ of the company in 1926 as a cooperative student from M.I.T. After his graduation from M.I.T. in 1928 with degrees of B.S. and M.S. in electrical engineering, Mr. Alimansky became a member of the capacitor engineering section in 1929 and in 1937 he was transferred to the Transformer Division of the Central Station Department.

Charles F. Miller, who succeeds Mr. Alimansky as manager of capacitor sales, has been with G.E. since 1922 when he was assigned to the distribution transformer engineering department. In 1925 he was transferred to the company's general offices at Schenectady, and the following year he became a transformer specialist in the New York district, a position which he held until his return to Pittsfield in July, 1942. A native of Utica, N. Y., Mr. Miller was graduated from Tri-State College in Angola, Indiana, with a B.S. degree in electrical engineering.

Fred G. Stebbins, named assistant manager of sales of the distribution transformer and feeder section, is a native of Little Falls, N. Y., and was graduated from Union College in the class of 1918 with a degree of B.S. in electrical engineering. With a background of various earlier assignments in the G-E "Test" course, he spent 4 yr. in general sales work with G.E. International. He became associated with the Transformer Division at Pittsfield early in 1930.

VIBROSCOPE, INC. will move their factory and office May 1st, 1943. The new address will be: 6 East 39th Street, New York, N. Y. This company manufactures the Davey Vibrometers and Portable Balancing Equipment.

Following the organization meeting of the Board of Directors of Philco Corporation, Larry E. Gubb, chairman, announced that the Board had elected James T. Buckley, president of Philco Corporation, to the newly-created office of chairman of the company's executive committee, and had named John Ballantyne, who has been serving as vice-president in charge of operations, president of the company. M. W. Heinritz of Trenton, N. J., formerly general manager of the company's storage battery division, was name vice-president in charge of the division, and Charles F. Steinruck, Jr., assistant secretary, was elected secretary in place of George E. Deming, who died April 15th. All other officers were re-elected.

HOW STAYNEW FILTERS HELP AMERICA AT WAR

THROUGHOUT American industry, Staynew Filters increase production, reduce maintenance. More guns, planes, tanks, ships, shells, trucks, and war materials of every kind are produced and moved faster to the fighting fronts because Staynew Filters are on the job.

At the fighting fronts, Staynew Filters add to the deadly efficiency of American weapons. Many a U. S. fighting man today owes his very life to the greater fire-power, speed, efficiency, or reliability of Staynew-equipped instruments of war.

After Victory, Staynew Filters will again help peacetime industry produce better, cheaper, faster.

Partial List of Staynew Filters and Their Direct Application to America's War Effort

STAYNEW INTAKE FILTERS help maintain maximum performance of tank, truck, and marine engines by preventing the intake of abrasive dust.

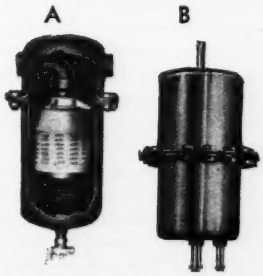
PROTECTOMOTOR AIRCRAFT-TYPE FILTER CELL →

CIRCULAR TYPE AIR INTAKE FILTER

STAYNEW INTAKE FILTERS (Aircraft-type) help maintain a sufficient supply of clean air to aircraft carburetors and engines.

MODEL CPHLS LIQUID LINE FILTER

STAYNEW LIQUID LINE FILTERS add to long life and reliability of internal combustion engines for airplanes, tanks, trucks, and naval vessels by removal of gritty particles and carbon from fuel and lubricating oils. These filters speed war production by removing foreign matter from coolant oils; they guarantee clean water in the field for photo-processing; they are capable of handling algae-bearing water.



A—Model CPH Oil Vapor Arrestor.
B—Model CP Aircraft-type Oil Vapor Arrestor.

STAYNEW OIL VAPOR ARRESTORS prevent oil from crankcase breathers reaching blades of engine turbo-chargers; also prevent oil from the discharge of rotary or other types of compressors damaging or fouling accessory apparatus and control mechanisms.

Automatic Type Ventilation Filter

STAYNEW FILTERS for building ventilation, including automatic and dry panel types, are contributing everywhere to the continuity of service of both men and machines.

BUILDING AIR SUPPLY FILTER

Have You A Filter Problem?

The broad experience of Staynew engineers is proving invaluable in solving war industry problems. This experience, product of more than 22 years of exclusive filter manufacturing, is yours for the asking.

OVER ONE MILLION STAYNEW FILTERS PLACED IN SERVICE

STAYNEW FILTER CORP.

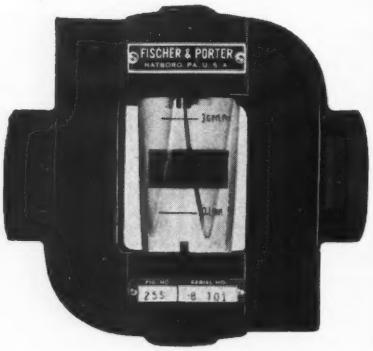
PROTECTOMOTOR AIR FILTERS

"Filter Headquarters"

31 FILTER PK., ROCHESTER, N. Y.

Important Notice for PROCESS DESIGN INSTRUMENT } ENGINEERS

New Flow Rate Indicator gives instantaneous response to flow change



THE Fischer & Porter Rota-Sight is the logical flow rate indicator for any application where an approximation of the amount of fluid flow rate is an operating aid and necessity. The Rota-Sight has literally thousands of uses such as for measuring flows of cooling water, air agitation, gas blanketing, gas leakage, lubricating oils, filter feeds, filter back wash, overflows, circulating mediums and coagulating additives. Nothing as simple and inexpensive as the Rota-Sight has ever been available for the countless fluid flows where you would like to know exactly what you are doing.

The Rota-Sight offers these distinctive advantages:

1. Tells the operator the instant that the flow changes.
2. The indicating rotameter-type float gives wide range over short scale length.
3. Float is visible in opaque liquids.
4. Warns operator when flow is too high or too low.
5. Easy to install — universal inlet and outlet connections.
6. Nothing to get out of order.
7. Inexpensive.
8. Sizes ½" to 2½"—flows to 57GPM or 130CFM.
9. Available in cast iron, bronze, and steel as standard materials—obtainable in any corrosion resistant metal that may be cast, such as stainless steel, hastelloy or durimet.

We suggest that you take immediate operating advantage of this new, sensitive flow rate indicator. Write today for Bulletin 101, Fischer & Porter Company, 595 County Line Road, Hatboro, Pennsylvania.

F&P ROTA-SIGHT

Manning, Maxwell & Moore, Inc., manufacturers of Consolidated Safety and Relief Valves, Ashcroft Gauges, American Glass and Dial Thermometers, American Industrial Instruments, and Hancock Valves, with plants at Bridgeport, Conn.; Boston, Mass.; and Muskegon, Mich., has opened a new plant in Tulsa, Okla., to manufacture oil relief valves. When the plans for this new plant were first made, the War Production Board, deeming the plans so important, cleared the way for quick delivery of all essential materials. The plant is now in operation.

The important key men are G. P. Kirchhofer, Plant Manager; John Scott, Superintendent; and James W. Schwarberg, Jr., Office Manager and Purchasing Agent. The District Sales Office under the direction of Malcolm Black, Southwestern District Manager, will continue at 317 East 4th Street, Tulsa. Hugh A. Brightwell has joined the staff as a sales and service representative.

Fairbanks, Morse & Co. have announced the appointment of Robert H. Morse, Jr., as General Sales Manager. Mr. Morse, Jr., comes to his new duties with a long and varied experience, beginning in 1916, in the service of the company and its subsidiaries. This experience includes 10 yr. in the manufacturing divisions, followed by extensive sales experience as Manager successively of the Cincinnati, Dallas, and Boston Branches, and the Stoker Division; and more recently as Assistant Sales Manager.

Thomas C. Finnell has been appointed manager of the Industrial Department in the Eastern District of the Westinghouse Electric & Mfg. Co. Mr. Finnell succeeds C. W. Miller, who was named Manager of the Application Department of the Westinghouse Radio Division at Baltimore. In his new post, Mr. Finnell will supervise the supplying of electrical equipment to war industries throughout New York State and northern New Jersey.

Mr. Finnell joined Westinghouse in 1929 when he entered the Company's graduate student course at East Pittsburgh. He was assigned to New York in 1931, where he served as an application engineer until his newest appointment. Born in St. Paul, Minnesota, October 10, 1905, Mr. Finnell attended Central High School there and the University of Minnesota in Minneapolis where he received a Bachelor of Science degree in Electrical Engineering in 1929.

The Power Specialty Co. of Houston, Texas, announces the association of Mr. R. H. Knipping with the firm as a member. He will shortly take over the San Antonio, Austin, Corpus Christi territory which he covered some years ago. Mr. Knipping has had wide experience in the application, operation and servicing of the lines the company handles. Power Specialty Company are the agents for Centrifix Corp., Cochrane Corp., Erie City Iron Works, Foster Engineering Company, Hays Corporation, J. E. Lonergan Company, Lummus Company, R-S Products Corp., and Thomas C. Wilson, Inc.

Folke Richardz, an engineer for 17 yr. with the Westinghouse Electric & Mfg. Co., has been appointed manager of engineering in the Company's Gearing Department at the Nuttall Works, Pittsburgh, Pennsylvania. He suc-

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HELPFUL BULLETINS

Practical answers to many wartime problems of plant operation and maintenance are found in the engineering bulletins offered by manufacturers. For your convenience we publish the following summary of helpful literature available. To obtain copies of the bulletins and catalogs described, simply indicate the paragraph numbers on coupon on next page, detach and mail.

BOILER PLANT EQUIPMENT

1 Multiple Spreader Stoker—"Burns Coal Like Oil" is the title of the new 12-pg., board-bound brochure which describes the Fyr-feeder multiple spreader stoker and the work that it is doing in various Army, Navy and Defense Power Plants, as well as on oil conversion jobs. American Coal Burner Co.

2 Boiler Tube Cleaner—New Catalog No. 42 deals with selection of proper tube cleaning equipment for power plants, refineries, marine boiler rooms. Also describes Wilson tube cleaners operated by air, steam, water, electricity. Thomas C. Wilson, Inc.

3 Hints On Stoker Operation—New handbook "Fundamentals of Stoker Operation and Maintenance" should be helpful to those faced with the problem of making present stokers last for the duration. Also contains suggestions for converting to stoker firing. Data applies to all types, regardless of manufacturer. Combustion Engineering Co.

4 Portable Steam Plant—New bulletin gives performance data and dimensions on Preferred unit steam generator. Burns light or heavy oil; sizes up to 500 b.hp.; full or semi automatic operation. Conversion efficiency said to be over 80%. Preferred Utilities Co.

5 Refractory Selector—Handy bulletin contains selector chart for choosing proper refractory for furnace doors, arches, baffles, ash pits, etc. Also provides color scale for temperature and other working data useful to boiler room and maintenance engineers. The Wahl Refractory Products Co.

6 Underfeed Stokers—Engineering Bulletin describes F & E stokers as applied to power and heating installations—wide range, hydraulic drive, complete control, backed by 25 years of successful stoker manufacture.—The Flynn & Emrich Co.

7 Fuel Oil Treatment—A description of the Perolin fuel oil treatment to improve oil burning efficiency is given in recent bulletin. It is said this treatment converts sludge into heat, emulsifies water in oil, keeps lines and burners clean. Perolin Co.

8 Spreader Stoker—Catalog 619, 36 pg. and plastic bound, describes the principle and operation of the pneumatic spreader stoker, illustrates all models and gives photographs, diagrams and detailed descriptions of ten typical installations. Iron Fireman Mfg. Co.

ELECTRICAL EQUIPMENT

9 Synchronous Motor Control—12-pg. booklet describes starting, accelerating, synchronizing, normal running, pull-out and undervoltage protection as performed by magnetic and semi-magnetic full- and reduced-voltage synchronous-motor controls. Also listed and described are several metal cabinet-type enclosures for protecting these controls. General Electric Co.

10 Lighting Guide—Up-to-the-minute information on the use of fluorescent luminaires for factories and offices is given in new lighting catalog. Includes useful diagrams, specifications, price lists. Martin-Gibson Light & Tile Corp.

11 Maintenance Manual on Electric Tools—A new 20-pg. pocket size booklet contains helpful instructions on the operation and care of all types of portable electric tools. Special attention is given to the more common problems in connection with the maintenance of the motor, cable, switch and brushes. "Right" and "Wrong" operating methods are clearly stated and pictured with simple instructions. Full information on what to do when a tool fails to operate is also covered. Independent Pneumatic Tool Co.

12 Motors Maintenance—"A Guide to Wartime Care of Electric Motors" is a useful handbook on the maintenance problem of motors under hard service and unfavorable conditions. It is applicable to all types of motors and tells the cause and correction of troubles due to dirt, oil, moisture, vibration, misalinement, wear and overload. A check list of symptoms you can see, hear and feel serves as a diagnosis chart. Allis-Chalmers Mfg. Co.

13 Wire and Cable—Catalog devotes one section to technical data on G-E asbestos insulated wire and cable; supplies other interesting data on this complete line of power cables, switchboard and appliance wires, fixture wires and cords, locomotive cords, magnet wires, etc. General construction specifications listed for each product. General Electric Co.

FANS, PUMPS AND COMPRESSORS

14 Pump Bulletins—Complete details on Warren pumps are contained in bulletins 228 and 229. Dimensional data, capacities, etc. on a complete line of centrifugal, liquor, duplex and single piston, plunger, vacuum, etc. will enable you to find just the pump to fit your particular needs. Warren Steam Pump Co.

15 Centrifugal Blowers—New Bulletin 120-B-12 covers the applications, operating characteristics and construction details of Roots-Connersville centrifugal blowers and exhausters. This is a 20-pg. booklet well illustrated, deals with both single and multi-stage units. Roots-Connersville Blower Corp.

16 Drainage and Sewage Pumps—Yeomans Pumps for drainage, sewage, heating systems, etc. are pictured and described in 12 pg. bulletin. Contains helpful dimension and selection tables. Yeomans Brothers Co.

INSTRUMENTS AND CONTROLS

17 Gages for Measuring Liquids—Bulletin 1037 describes a complete line of liquid level gages for measuring liquids of all kinds whether light or heavy. Dial readings can be provided in feet, inches, gallons, pounds, liters or by any other desired increment. The Liquidometer Corp.

18 Smoke Meter—The Photovolt Photoelectric Smoke Meter recently placed on the market is described in a bulletin now available to those interested in such a device. This smoke meter is designed to furnish an objective indication of the density of smoke, independently of individual judgment and of light conditions. It was designed to test the smoke of Diesel engines but it is not restricted to this application; it is equally useful with other internal combustion engines and with furnaces. Photovolt Corp.

19 Steam Engine Indicator—Illustrated Bulletin T-421 pictures the action of the Trill steam engine indicator and indicator cocks. Indicator spring is located outside and is easily attached. Trill Indicator Co.

20 Feed Water Regulators—Bulletin S-20-D describes a simple, dependable and ruggedly built line of feed water regulators. Protects your boilers from dangerous water stages. Easily installed on any boiler. The Swartwout Co.

21 Boiler Meters and Control—Bulletin No. 16 entitled "How to Safely Stretch Steaming Capacity." An aid to power engineers who are faced with the necessity of meeting increased steam demands and who will be obliged to operate the boiler plants on a 168-hour week schedule. Practical suggestions are made, many of which can be carried out without the use of elaborate metering or control equipment. Bailey Meter Co.

List Items You Want On Handy Coupon On Following Page

22 Boiler and Tank Gages — New Bulletin W43 describes operating features of Ernst bronze, forged steel and all iron gages for boilers, tanks, refineries, etc. Includes useful specification data. Ernst Water Column & Gage Co.

MECHANICAL TRANSMISSION

23 Handbook on V-Belts — 16-pg. pocket-size handbook entitled, "Plain Facts on Wartime Care of Rubber V-Belts," applies to all makes of V-belts and explains ways V-belt construction affects its maintenance, what determines life expectancy of a set of V-belts and what to do about worn sheaves. Allis-Chalmers Mfg. Co., Texrope Div.

24 Bearing Metal Handbook — 8-pg. bulletin describes various lead-base metals which have proved to be excellent substitutes for tin-base bearing metals. Also contains suggestions for best results in making and maintaining journal bearings, and a table of recommendations for selecting correct bearing metal for 135 different types of machinery. Magnolia Metal Co.

25 Low Power Drives—Worm gear units for 3 in. and 3½ in. center distances are described in Leaflet E-1219. These gears are supplied for either top or bottom drive and in ratios from 3⅝ to 1 up to 60 to 1, and are intended particularly for the operation of low-power machinery, such as small mixers, dryers, automatic furnaces and ovens, churns, conveyors and elevators, mechanical stokers, etc. The lower ratios can be used as speed-increasing gears where the maximum worm speed does not exceed 1750 r.p.m. De Laval Steam Turbine Co.

26 Belting Maintenance Handbook—"How To Get The Most From Your Leather Belting" is the title of a helpful 24-pg. book recently issued. Includes practical tips on how to make belts endless on the job, alignment of shafting and pulleys, belt maintenance, etc. J. E. Rhoads & Sons.

PIPING, VALVES AND FITTINGS

27 Vacuum and Lifting Traps—Catalog 64 describing traps for the removal of liquids (water, oil, gasoline, etc.) from low pressure or vacuum and discharge of them to atmosphere or against a higher pressure. Strong, Carlisle & Hammond Co.

28 Where to Use Valves, Drains, and By-Passes—Thirty-two pages of interesting information tells you which valves to use, differences among the various types of valves, the fundamentals of valve designs and application, and lists A. S. M. E. power boiler code valves. Jenkins Bros.

29 Romance of Piping—Spring issue of "Sparks," a house magazine, contains attractively illustrated history of development of piping from crude logs to present welded systems. A valuable booklet for all piping men. Tube Turns.

30 Valves, Boiler Mountings—Catalog 78 describes Bronze, Iron and Steel Valves, Boiler Mountings, Lubricating Devices, Air Devices and numerous other specialties. In addition to the technical and dimensional data relating to the products, there is a section on the thermodynamic properties of steam, and a table of shipping weights. Lunkenheimer Co.

31 Trap with No Moving Parts — Latest Drainator catalog describes a steam trap with no moving parts for removing condensate, air and non-condensible gases from steam lines. Capacity tables and charts, photos of typical installations and tables of sizes included. The Coe Mfg. Co.

32 Steel Valves — Catalog 101, condensed summary of better valves for boiler rooms, petroleum plants, utility, industrial plants—handbook filled with complete design, dimensional and application data and illustrations. The Edward Valve & Mfg. Co., Inc.

33 Steam Trap Guide—"How to Choose a Steam Trap" is the title of a new informative steam drainage guide, 40 pg. of condensation rate charts, graphs, tables — formulas for computing condensing capacity of steam using equipment — trap sizes for unit heaters, header drips, jacketed kettles, etc. The V. D. Anderson Co.

34 Control Valves — Catalog 140, 16 pg., describes Nicholson flat disc design in 2, 3, 4-way and special types for operating single and double acting cylinders, with air, steam, oil, gas or water — lever, foot, solenoid or motor operated — for applications up to 5,000 lb. pressure. W. H. Nicholson & Co.

35 Joint Tightness — Handbook, 40 pg., tells how to make up tight threaded flanged and hub joints speedily, and to seal leaking joints by ing ous time-saving and money-saving pairs to plant equipment. Smooth Mfg. Co.

36 Seamless Flexible Metal Hos Bulletin H-935 furnishes engin with complete data covering the ph cal properties and other pertinent formation. Containing many illus tions, cuts and diagrams, it is invalu to engineer, designer, and specifica man who uses metal hose. Eclipse ation Seamless Flexible Metal H Philadelphia Div. of Bendix Avia Corp.

WATER TREATMENT

37 Water Treatment Data — (pletely revised data book on w treatment contains 78 sections of da addition to 36 tables and 10 graphs has hundreds of chemical convers and equations. Gives methods of culation of water conditioning prob and should be in the library of e engineer or chemist who comes in tact with water treatment. Perm Co.

38 Hot-Process Water Softene New 24-pg. Catalog No. 7500 features hot-process water so ers with numerous installation ph graphs, cross-sectional and line grams, charts and tables. Also cont general engineering data. Graver T & Mfg. Co., Inc.

39 Water Conditioning—Bulletin 30 — Questions and Answers Boiler Feedwater Treatment — a p tical booklet of immediate help to man in the plant. National Alumi Corp.

40 Deaeration of Boiler Feedw Explained—A new 36-pg. bu tin on tray-type deaerators—atmo deaerators—deaerating hot water erators and—cold water deaerators sections devoted to: Flow diagrams cluding photographs of installations scribed; corrosion control; pH cont metering deaerating equipment V-Notch recorder and electrical tems for recording flow at a dista when the recorder is located on a tralized panel board. Cochrane Co

MISCELLANEOUS

41 Quick Floor Repairs — Fol "Floor Patch" describes a pro that repairs floors immediately and lows you to open the spot to reg traffic immediately. Floor patch solid and permanent. This new pla bonds tight to old concrete and w stands extreme loads. Flexrock Co

42 Condensate Units—4-pg. Bull 1142 describes simplex and plex "Series G" Schaub condens return units. The units, compact design, use a minimum of critical m rials and can be used for a variety condensation return requirements. cluded are dimensional data and il trations. Fred H. Schaub Engineer Co., Inc.

43 Lubricants — Publication enti "The Service Factor" is devo to the solution of lubrication proble and describes specialized lubricati steam cylinder and valve oils, etc. fill your particular needs. Sinclair fining Co.

This coupon should be filled in completely in order to secure the literature you request. Please indicate only the bulletins you particularly desire. Pasting coupon on penny postcard saves you time and money.

MAY, 1943

POWER PLANT ENGINEERING

53 W. Jackson Blvd.
Chicago, Illinois

Please have the manufacturers send me without obligation the literature indicated by the following paragraph numbers:

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Your Name .....

Your Title .....

Name of Company .....

Company Address .....

City..... State.....

(If you prefer delivery at your home address also fill in the following spaces.)

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Cast Iron Unit Heaters—A description of the "Grid" cast iron heaters, introduced in 1942 as a substitute for aluminum heating sections to cooperate with the war effort, contained in a catalog sheet, just off the press, offered by D. J. Murray Co.

Hydraulic Packing—The scientific specification and accurate shop control of hydraulic and pneumatic packing is detailed in an operating manual. Hydraulic service improvements developed by Wayne Davies with data and information enabling maintenance engineers to determine exact requirements and dimensions for every condition are included. Wayne Davies &

Corrosion Data—A new corrosion data work sheet has been developed to assist executives and engineers in their study of corrosion problems. Acts as a check list to insure consideration of all factors influencing corrosive action. It also permits ready comparison of a problem with similar ones which may be used as a guide for selecting satisfactory materials. The International Nickel Co.,

Roof Ventilators—Advantages and capacities of Asbo round roof ventilators are described in a recently issued bulletin. Contains design and engineering data of value to ventilating engineers. American Steel Band Co.

Hard-Facing Materials Data—Handy 4 pg. bulletin describes the application of Haynes Stellite, Haynite and similar hard-facing materials on pump rods, coal crusher rolls and other equipment subject to abrasive wear and impact. Contains helpful application data. Haynes Stellite Co.

Paint—Patented paints and other materials for the repair and upkeep of wooden tanks and the rust-proofing of steel hot water and storage tanks are described in a new booklet issued by Paint-Point Products Co.,

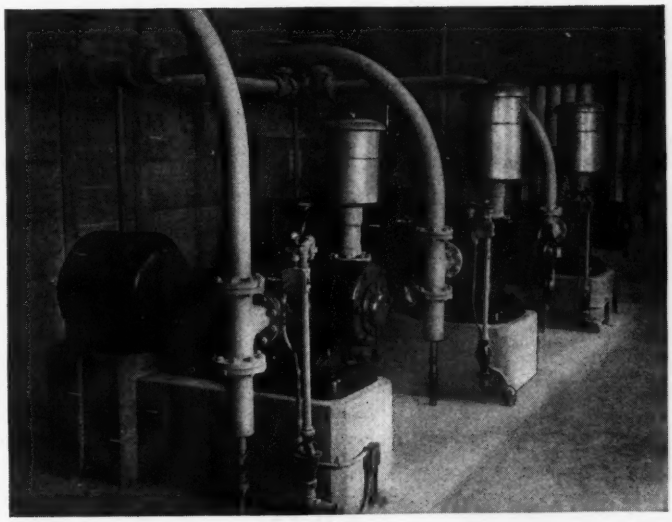
Seamless Copper Floats—Catalog describes Hercules seamless copper floats which help insure carefree maintenance of water level in heaters, tanks, water columns, etc. Hercules Metal Works.

Induced Draft Cooling Towers—Bulletin 603 shows blueprint lay-outs and installation views of Marley conventional type induced draft cooling towers. Also describes bulletin on other water cooling equipment. The Marley Co.

Hard-Facing Weld Rods—Engineers and maintenance men faced with the problem of building up worn pump valves, pump sleeves, crusher rolls, etc. will want a copy of the 12 pg. booklet, "Hard-Facing With Coast Metals." Contains useful specifications and application pointers. Coast Metals,

Care Of Fire Extinguishers—A new booklet entitled "Maintenance and First Aid Fire-Fighting Equipment" is divided into six sections: (1) Vaporizing Liquid, (2) Soda Acid, (3) Foam, (4) Anti-Freeze, (5) Carbon-Dioxide Extinguishers, and (6) up-to-date charts giving complete data in condensed form as to extinguisher and fire characteristics, methods of operation, capacity, range of stream, etc. American-LaFrance-Foamite Corp.

A West Coast Company uses 16 FULLER ROTARIES



Just another result of the satisfactory operation of one Fuller Rotary Compressor installed in 1934 by a West Coast cement company. The excellent over-all performance of this initial installation "sold" this company on Fuller Rotaries. Result—the installing of 16 units up to the present time. Included in this total are seven machines purchased in 1940, when it was decided to rebuild and modernize this plant, three of which are shown in the above illustration.

As time goes on, more and more plant superintendents and engineers are specifying and installing Fullers. They're the ideal unit for general industrial use for capacities to 1800 C.F.M. actual free-air delivery, pressures to 125-lb., vacuums to 29.90-in. (referred to 30-in. barometer).

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C-68

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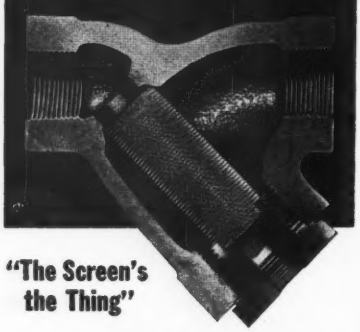
PIONEERS OF HIGH-EFFICIENCY ROTARY COMPRESSORS

Prevent RUST SCALE DIRT From Clogging Steam Equipment

YARWAY STRAINERS



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- *Body Cadmium Plated Inside and Out for Protection Against Corrosion.*
- *Readily Removed Steel Blow-Off Bushing.*
- *Bushing Automatically Aligns Screen.*
- *Thousands in Use—Sold by Over 100 Mill Supply Houses.*
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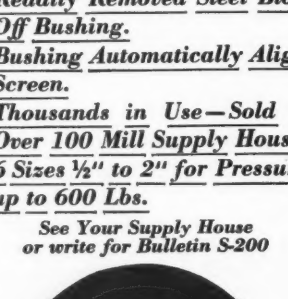
See Your Supply House or write for Bulletin S-200



YARNALL-WARING COMPANY
114 Mermaid Ave. PHILADELPHIA

(*Continued from page* 174)

ceeds S. L. Crawshaw, resigned. Mr. Richardz was graduated in 1921 from the Institute of Technology in Katerineholm, Sweden, with a mechanical engineering degree. He joined Westinghouse in 1926 as a design engineer in the radio and photophone department at East Pittsburgh. In 1931, Mr. Richardz was assigned to the Nuttall Works as a design engineer, being appointed section engineer in the Gearing Department a year later.

Dr. Charles M. Slack, research physicist, has been appointed assistant director of research at the Westinghouse Lamp Division, Bloomfield, N. J. Dr. Slack is well known in the field of electronics research and for his contributions to the development of an ultra high-speed X-ray machine that is making possible the wartime studies of bullets as they crash through armor plate. In his new position as assistant to Dr. Harvey C. Rentschler, research director, Dr. Slack will direct experimental work on various lamp and electronic problems.

Additional responsibilities also have been assigned to Dr. John W. Marden who has been assistant director of research for the past 15 years. Although continuing in his present position, Dr. Marden will assume complete charge of metals research, an activity which has expanded greatly since the outbreak of the war.

NEW ENGINEERING BOOKS

Mathematics Dictionary. Revised Edition. By Glenn James and Robert C. James. Size 6 by 9 in., 319 pp., flexible fabricoid binding. Published by The Digest Press, Van Nuys, Calif. Price $3.00.

This revised edition of the Mathematics Dictionary has been designed primarily to meet the need of the student and to provide a condensed source of facts and principals for men in the practical field. It is a condensation of the definitions of basic words and topic phrases used in mathematics, including a complete coverage of those ordinarily used in arithmetic, elementary algebra, plane and solid high school geometry, college algebra, mathematics of finance, trigonometry, analytic geometry, and differential and integral Calculus. In the appendix to the book there are eight tables of common logarithms, trigonometric functions and their logarithms, amount of one dollar at compound interest for n years, present value of one dollar due at end of n years, amount of an annuity of one dollar per year for n years, present value of an annuity of one dollar per year for n years, American experience table of mortality, squares, cubes, square roots and cube roots of integers, followed by denominate numbers, differentiation formulas, integral tables, Greek alphabet and mathematical symbols.

This revision emphasizes the simplification of elementary concepts in the interest of students in secondary schools and the laymen. For the more advanced students many of the basic

Reduce boiler scale TO GET MAXIMUM POWER!

WITH an accurate 2-minute check on pH and phosphates in your boiler water, you may prevent scale . . . increase heat transfer . . . get more heat with less fuel. The Taylor Boiler Water Comparator is equipped with a High (5-100 ppm) or Low (0-25 ppm) Phosphate Comparator, together with Cresol Red, Phthalein Red and Acyl Red color standard slides and accessories. All standards carry an UNCONDITIONAL GUARANTEE AGAINST FADING! Price Complete, $50., f.o.b. Baltimore. Saving of one descaling job pays for it!

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The De Laval-IMO Oil Pump is exceptionally simple and compact. It has only 3 moving parts and no gears, valves or separate bearings. Internal parts are easily accessible. Any grade of oil is delivered at any rate of flow against any pressure and without pulsation. The pump can be coupled to a standard speed motor or turbine.

Ask for Publication 1-105.

IMO PUMP DIVISION
of the De Laval Steam Turbine Company
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AST YEAR'S BONDS GOT US STARTED

THIS YEAR'S BONDS

ARE TO WIN!

Last year saw nearly 30,000,000 workers voluntarily buying War Bonds through some 175,000 Pay-Roll Savings Plans. And buying these War Bonds at an average rate of practically 10% of their gross pay!

This year we've got to top *all* these figures—and top them handsomely! For the swiftly accelerated purchase of War Bonds is one of the greatest services we can render to our country . . . and to our own sons . . . and our neighbors' sons. Through the mounting purchase of War Bonds we forge a more potent weapon of victory, and build stronger bulwarks for the preservation of the American way of life.

"But there's a Pay-Roll Savings Plan already running in my plant."

Sure, there is—but how long is it since *you've* done anything about it? These plans won't run without winding, any more than your watch! Check up on it today. If it doesn't show substantially more than 10% of your plant's pay-roll going into War Bonds, it needs winding!

And you're the man to wind it! Organize a vigorous drive. In just 6 days, a large airplane manufacturer increased his plant's showing from 35% of employees and 2½% of pay-roll, to 98% of employees and 12% of pay-roll. A large West Coast shipyard keeps participation jacked up to 14% of pay-roll! You can do as well, or better.

By so doing, you help your nation, you help your workers, and you also help yourself. In plant after plant, the successful working out of a Pay-Roll Savings Plan has given labor and management a common interest and a common goal. Company spirit soars. Minor misunderstandings and disputes head downward, and production swings up.

War Bonds will help us win the war, and help close the inflationary gap. And they won't stop working when victory comes! On the contrary—they will furnish a reservoir of purchasing power to help American business re-establish itself in the markets of peace. *Remember, the bond charts of today are the sales curves of tomorrow!*

You've done your bit — Now do your best!

THIS SPACE IS A CONTRIBUTION TO AMERICA'S ALL-OUT WAR EFFORT BY

POWER PLANT ENGINEERING

BOILER FEED-WATER TREATMENT

ENGINEERED BY ILLCO lowers operation costs!

Economical to install, easy to operate, *external* treatment plants have been engineered by ILLCO for a wide variety of boiler feed-water problems. Equipment removes the detrimental constituents of the raw water at a cost which is less than that of older, inferior methods. Any desired alkalinity can be established and maintained.

CONSTANT WATER QUALITY

ILLCO External Treating Equipment produces water of a constant quality without continual supervision.

MACHINE TOOL PLANT ILLCO Duplex Feed-water Treatment Unit, blending sodium zeolite water with hydrogen zeolite water to produce a boiler make-up with zero hardness and with very low total solids and alkalinity.

MILK PROCESS PLANT Single-tank ILLCO Combination-Regeneration Boiler Feed Unit, regenerated simultaneously with salt and acid; produces same results as Duplex Equipment above. Cypress tanks avoid use of critical materials.

ZEOLITE SOFTENERS, FILTERS, AERATORS, etc. are also manufactured by ILLCO — Water Treatment Engineers. Send for complete descriptive literature.

ILLINOIS WATER TREATMENT CO.
850 Cedar St., Rockford, Illinois

TESTED IN THE LABORATORY * ILLCO-WAY * PROVED IN THE FIELD

terms beyond Calculus have been included. Terms from the more advanced courses will be included in a second volume which is now being planned.

The new edition includes more working examples and definitions have been simplified, irregular plurals added, typographical errors corrected, five place logarithm tables have been used instead of four place and extensive integral tables given.

Commercial Standard CS 105-43, Mineral Wool; Loose, Granulated or Felted Form, in Low-Temperature Installations, has been announced by the National Bureau of Standards, U. S. Department of Commerce in co-operation with the Industrial Mineral Wool Institute. The Standard covers both cold storage area and pipe line mineral wool insulation. Based on extensive research by fully qualified engineers comprising the Institute's Specifications Committee, it also includes recommendations by engineers of the refrigeration field generally. The Standard is considered a major contribution to the war effort in the preservation of perishable food and the maintenance of process temperature controls so important in the manufacture of such war-time essential products as chemicals, synthetic rubber, and aviation gasoline. Until the printed Standard is available, mimeographed copies of Commercial Standard CS 105-43 may be obtained free of charge from the Trade Standards Division, National Bureau of Standards, Washington, D. C. Single copies may be secured without charge from the Industrial Mineral Wool Institute, 441 Lexington Ave., New York, N. Y.

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Experienced, capable, sober and reliable man for steam turbine electric plant in a City of the South. High school graduate, or better, preferred. Drifters and seekers for high wartime pay rates need not apply. If you are looking for a normal position, at good rates, give names of references, age, family situation, draft classification, education and full outline of experience in first letter. References will not be contacted until your permission is given. Address Box 1417, c/o Power Plant Engineering, 53 W. Jackson Blvd., Chicago, Ill.

POWER PLANT SUPERVISOR

WANTED—Man to supervise and take charge of maintenance and repair work in large dry milk plant. Plant does not generate own power. Will have charge of firemen and engineers and all maintenance men. 24 hour operation, 7 days per week—responsibility. Good salary and permanent position for proper man. Must have Engineer's license. Address Box 1419, Power Plant Engineering Co., 53 W. Jackson Blvd., Chicago, Ill.

Help Wanted

POWER PLANT SUPERVISOR

Large industrial company operating own power plant in Waterbury, Connecticut, is seeking night power plant supervisor. Must be United States citizen, preferably between 35 and 40 years of age, with suitable experience in public utility, or large industrial plant, or turbo generators, steam and air units. State salary expected. Box 1418, Power Plant Engineering, 53 W. Jackson Blvd., Chicago, Ill.

MECHANICAL ENGINEER

MECHANICAL ENGINEER wanted, who is experienced in pipe line design and detail for steam power and industrial plants to work in engineering and drafting office of manufacturer of electrical conductors, located in New York State. Address Box 1421, Power Plant Engineering, 53 W. Jackson Blvd., Chicago, Ill.

Used Equipment Wanted

EQUIPMENT WANTED

HYDRAULIC TURBO-GENERATOR—Preferably 110 foot head, 5000 K.W., 3 phase, 60 cycle with switchboard, etc. Will consider offers of any part or anything over 2500 K.W. Address Box 1420, Power Plant Engineering, 53 W. Jackson Blvd., Chicago, Ill.

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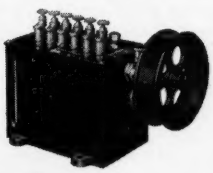

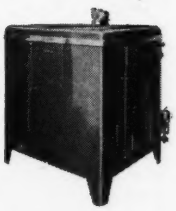

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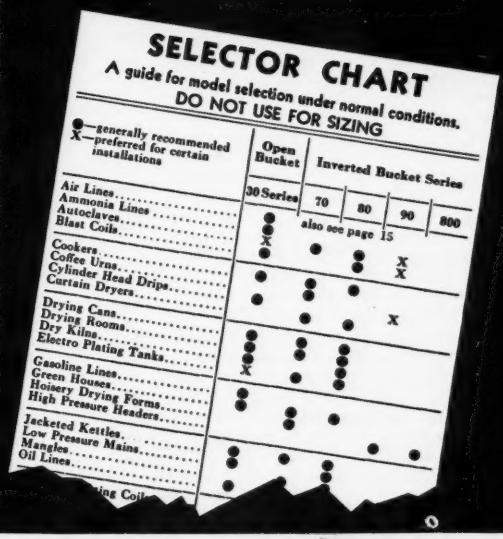

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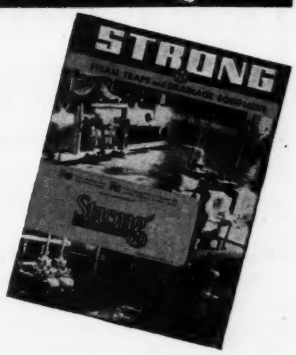

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Economy Loading of Power Plants and Electric Systems. By M. J. Steinberg and Theodore H. Smith. Size 6 by 9 in., 203 pp., cloth bound. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price $3.50.

This book contains a thorough discussion, both mathematical and non-mathematical, of the incremental rate theory, the modern way to solve load-division problems. It derives the mathematical conditions for obtaining maximum overall efficiency by the loading of equipment in parallel operation, then applies incremental rates in the academic solution of load-division problems. It describes limitations in the application of the incremental rate theory, tells how to operate your equipment for maximum efficiency not only in the plant but in the system; tells when to interchange energy and how much energy to interchange; gives the cost of supplying the energy to the interconnection and the value of the energy received from the interconnection; finally, it gives the practical solution of load-division problems. Numerous simple illustrations show how the principles may be applied.

The authors are both connected with the Consolidated Edison Co. of New York and have developed the material in this book over a period of years during which they have been engaged with problems of load-division, system development, economics of production, power plant testing and analysis of station performance for one of the largest electric systems in the world. The incremental rate theory which they discuss in the book may be applied to load-division problems existing in any electric system.

Electrical and Radio Dictionary, by Carl H. Dunlap and Enno R. Hahn. Size 5½ by 8½ in., 110 pp., cloth binding. Published by American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Price $1.00.

This is the eighth printing of this popular book, excellently adapted for use by individuals for home study work and by schools for classroom and reference work. There are 52 pages devoted to electrical terms and 14 pages to radio terms and in addition to these definitions the book contains several pages of symbol drawings and opposite each is a picture of the object the symbol represents. Several motor and starter diagrams are included, as well as numerous electrical formulas and handy tables relating to energy and torque, power, etc. There is also an explanation of the National Electric Code Standards including tables for copper wire, motor wiring, etc.

Heating Ventilating Air Conditioning Guide, 1943. 21st Edition. Size 6 by 9 in., 1160 pp., cloth bound. Published by the American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York City. Price $5.00; with thumb-index, $5.50.

This new edition of the Guide contains much new information of value to men in the engineering branches of the armed services and men in industry who are concerned with problems of heating, ventilating and air conditioning. The book contains 48 chapters of technical data and general information, including all phases of heating, cooling, ventilating and air conditioning, and related phases of refrigeration. Much new data has been added and large part of the book has been revise and rewritten.

Among the subjects revised an brought up to date are: Thermody namics of air and water mixtures; He Transmission Co-efficients; Heati Load; Estimating Fuel Consumption Radiators and Convectors; Hot Wat Heating Systems and Piping; Mechan ical Warm Air Systems. New da has been included on Unit Heater Ventilators, Humidifiers, Air Cond tioners, Air Coolers, Attic Fans and Ai Cleaning Devices where lint is an im portant factor. Important revision have been made in the chapters on Ai Distribution, Air Dust Design, Soun Control, Motors and Motor Control Industrial Air Conditioning and Ex haust Systems, Radiant Heating an Design of Solar Water Heaters.

A new chapter, entitled Abbrevia tions, Symbols and Standards, has bee added, and much valuable informatio on state laws and codes relating t heating, ventilating and air condition ing forms an entirely new section o the book. An Emergency War Prac tices section, outlining methods fo conservation of materials, has been ap pended to the Technical Data section

An important part of this newe edition of the Guide is the revise Catalog Data section in which muc useful equipment data has been sup plied by manufacturers. This section is grouped into sub-divisions for con venience in locating data and is pro fusely illustrated and supplemented b an Index to Modern Equipment t facilitate its use. In the back of th book is a Roll of Membership of th Society.

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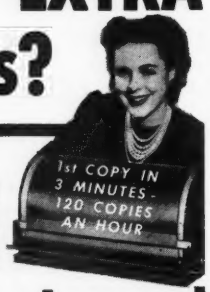

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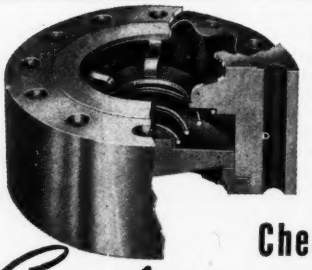

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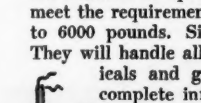
Williams-Hager valves may be used in *any* position and are noiseless in operation. They are built of materials to meet the requirements of any service and of pressures up to 6000 pounds. Sizes range from 1" to 20" inclusive. They will handle all liquids, hot or cold, including chemicals and gas. Write for Catalog No. 142 for complete information.



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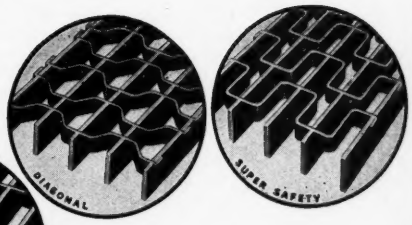

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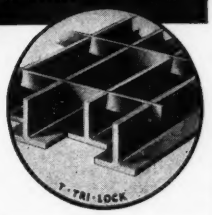

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In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.

Dense without being brittle—tough, yet resilient, Vulcodisc will not swell, warp or soften—in fact its absorption is less than 1 per cent. . . That is why an old Vulcodisc comes out of the disc holder as easily as a new one goes in. No need for hammer and chisel to cut the disc out in pieces—distorting and disfiguring the holder.

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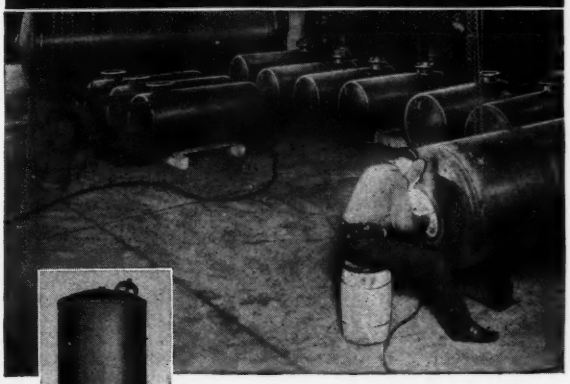

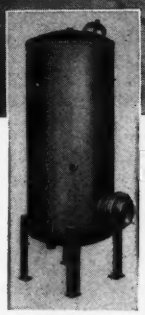

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Submit your heater problem to ADSCO engineers who will tell you the type, size, capacity, pressure and construction that will meet your needs and latest code standards. ADSCO can provide steel or copper tubing in accordance with governmental regulations in effect. Write for Bulletin No. 35-75E.

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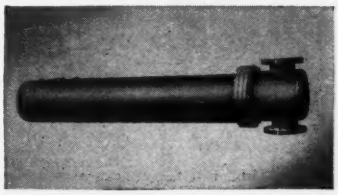

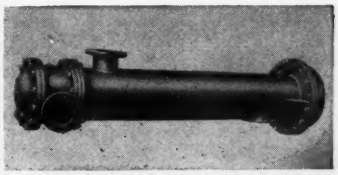

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Power Plant Construction News

Calif., Los Angeles—Cooper Screw Mfg. Co., 4466 Worth St., manufacturer of screw machine products, plans installation of electric power equipment in new one-story plant, about 130x200 ft. Cost over $85,000, including machinery. Work is scheduled to begin soon.

Colo., Walden—Western Fluorspar Corp., Cheyenne, Wyo., plans installation of electric power equipment in new fluorspar milling plant at mining properties in vicinity of Walden, entire project estimated to cost about $90,000. Work will begin soon. Knapp Engineering Co., 760 Folsom St., San Francisco, Calif., is engineer and contractor.

Conn., New Haven—Wire Rope Corp. of America, Inc., Congress Ave., manufacturer of wire rope, cables, etc., has plans maturing for new boiler house at plant, about 40x40 ft. Also will build new one-story addition, approximately 115x270 ft. Electric power equipment will be installed. Entire project is reported to cost over $100,000. Leo F. Caproni, 121 Chapel St., New Haven, is architect and engineer.

Fla., Miami—Blue Ribbon Distributors, Inc., 421 N. W. 32nd St., beverage products, plans early construction of two-story cold storage and refrigerating plant on N. E. 25th St., fronting on line of Florida East Coast Railway. It will be about 150x160 ft., reported to cost over $90,000, with equipment. R. DeC. Weakley, Congress Bldg., is architect. George W. Stewart is president.

Ill., Chicago—Studebaker Corp., 5555 Archer Ave., plans installation of electric power equipment in two new one-story additions to plant, operated for Government, about 80x640 ft., and 36x440 ft., for which superstructure will begin soon. Entire project is reported to cost over $1,000,000, and will be financed by Defense Plant Corp., Washington, D. C., federal agency.

Ind., Anderson—Light and Power Dept., East Eighth St., plans new power sub-station and extensions in transmission lines, for connection with system of Indiana General Service Co., Marion. Project is reported to cost about $40,000, and will be carried out jointly by two interests noted.

Iowa, Amana—Amana Society plans installation of electric power equipment in new two-story addition to woolen mills, about 60x125 ft. Cost reported over $50,000, with machinery. Work will be placed under way soon.

Ky., Eddyville—State Welfare Department, Capitol Building, Frankfort, plans installation of a refrigerating plant and system, capacity about 25 tons, at State Penitentiary, Eddyville. Cost estimated about $30,000. A priority rating has been secured and work is scheduled to begin soon.

Ky., Owensboro—Glenmore Distillery, Inc., has approved plans for new boiler house, about 46x56 ft., at plant, and will begin work at early date. No estimate of cost announced. Walter C. Wagner, Breslin Building, Louisville, Ky., is architect.

Mich., Detroit—Bower Roller Bearing Co., 3040 Hart St., manufacturer of roller and ball bearings, etc., plans installation of electric power equipment in connection with expansion in plant for production for Government, including new building and machinery for large increased capacity. Entire project will cost about $460,000, and will be financed by Defense Plant Corp., Washington, D. C., Federal agency.

Minn., Duluth—Duluth Shipbuilding Co., Duluth, plans installation of electric power equipment in connection with expansion in shipyard for production for Government. Entire project is estimated to cost about $300,000, with financing provided by Defense Plant Corp., Washington, D. C., Federal agency.

N. J., Newark—Wilbur B. Driver Co., 152 Riverside Ave., manufacturer of resistance wires, alloys, etc., plans expansion in plant for production for Government, including new building and facilities for large increased capacity. Electric power equipment will be installed. Entire project will cost about $260,000 and will be financed by

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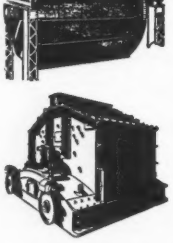
Reduce R.O.M. for Stoker or Pulverizer feed with absolutely no oversize and low "over-grinding." Crush by *gravity-impact*. Automatically eject, without damage, tramp iron, mine debris and hard rock. Low H. P. . . . slow speed . . . long life. Low upkeep . . . rugged . . . thoroughly dependable. 25 to 500 T.P.H. Steelbuilt. Patented.



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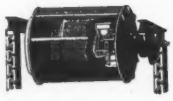

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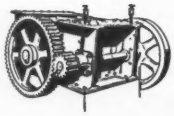

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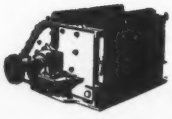

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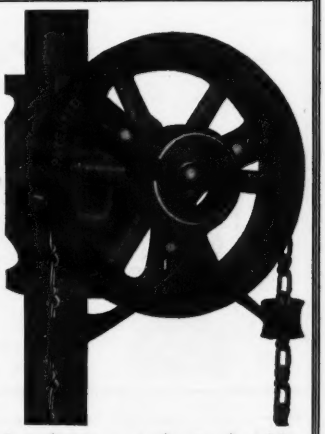

Every overhead valve in your plant should have the easy, safe, instant control from the floor which Babbitt Sprocket Rims provide. . . . Babbitt Rims are low in cost; quickly attached; they save time, steam and accidents. Install them now. Write for descriptive folder.

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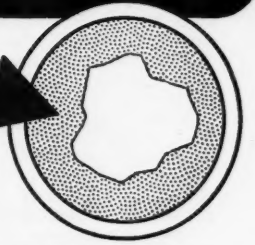
Adjustable
SPROCKET RIM
with Chain Guide

Remove FUEL WASTING SCALE



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To be fast and effective a tube cleaner must use a high percentage of the air power applied. In Airetool Tube Cleaning Motors the air or steam pressure under the blades holds them out against the cylinder at all times. This ingenious power seal prevents loss of pressure. For that reason Airetool Tube Cleaners can be loaded down to 50 R.P.M. without stalling. And, they will start under heavy loads. Cutter Head combinations can be used that will clean out the toughest scale formations.

Precision built Airetool Tube Cleaners are of slip-fit construction. They will slide apart easily without special tools when replacements are necessary. Even with this advantage, tolerances are so close that there is no loss of air.

There is an Airetool Cleaner for every scale or gummy tube condition. Cutter heads, drill heads, brushes and vibrator heads are made for tube sizes ranging from 1/2" I.D. to 20" I.D.

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Defense Plant Corp., Washington, D. C., Federal agency.

N. J., Paterson—Wright Aeronautical Corp., 132 Beckwith St., manufacturer of aircraft engines, has plans maturing for new boiler house at plant, reported to cost close to $50,000, with boiler units and accessories. Albert Kahn Associated Architects & Engineers, Inc., New Center Bldg., Detroit, Mich., is architect and engineer.

N. M., Pinos Altos—Continental Chemical & Ore Co., Silver City, N. M., plans installation of electric power equipment in connection with proposed development of zinc and lead ore properties, known as Savana Mines, in vicinity of Pinos Altos, including installation of mining machinery and construction of mill, shops and miscellaneous buildings. Entire project is reported to cost over $400,000.

N. C., Wilmington—Navy Department, Washington, D. C., plans large naval air station in vicinity of Wilmington, including hangars, shops and other industrial buildings. Electric power equipment will be installed. Also will build boiler house and power substation, with electrical distribution lines and complete facilities for light and power service. Entire project is estimated to cost close to $10,000,000; an initial appropriation of $2,000,000 has been authorized to begin work. George W. Carr, Durham, N. C., is architect and engineer for buildings.

Ohio, Cleveland — Harris-Seybold-Potter Co., 4510 East 71st St., manufacturer of printing presses, parts, etc., has approved plans for new boiler house and maintenance building, about 65x100 ft., reported to cost over $85,000, with boiler units and auxiliary equipment. Project will be financed by Defense Plant Corp., Washington, D. C., Federal agency. Contract for building erection has been let to Gillmore-Carmichael-Olson Co., 1873 East 55th St., and is scheduled to begin at once.

Ore., Portland—Pacific Chain & Mfg. Co., 1901 N. W. Wilson St., manufacturer of steel chains for conveyor and other service, plans installation of electric power equipment in new addition to plant, to be one-story, estimated to cost about $200,000. Production will be for Government, which will provide financing in amount noted through Defense Plant Corp., Washington, D. C., Federal agency.

Pa., Washington—Jessop Steel Co., Green St., manufacturer of carbon and highspeed steels, etc., plans installation of electric power equipment in connection with expansion in plant for production for Government, including new building and facilities for large increased output. Entire program will cost about $240,000, and will be financed by Defense Plant Corp., Washington, D. C.

Tenn., Knoxville—Rohm & Haas Co., Dale Ave., manufacturer of industrial chemical products, plans installation of new water-cooling system in local plant, reported to cost over $45,000. Main offices of company are at 222 Washington Sq., Philadelphia, Pa.

Tenn., Murfreesboro—Construction Division, Veterans' Administration, Washington, D. C., plans extensions and improvements in water-softening plant at institution at Murfreesboro, including installation of additional equipment for increased capacity.

Texas, Kingsville—Navy Department, Washington, D. C., has authorized extensions and improvements at naval air training base at Kingsville and Beeville, vicinity of Corpus Christi, including two new industrial shops. Electric power equipment will be installed. Also will build an addition to cold storage and refrigerating plant, and carry out other work. Entire project is reported to cost about $246,000.

Wash., Wenatchee—Wenatchee Alloys, Inc., manufacturer of metal alloys, plans installation of electric power equipment in connection with expansion in plant for production for Government, to provide facilities for considerable increased output. Cost estimated about $200,000. Project will be financed by Defense Plant Corp.

W. Va., Deepwater — Virginian Railway Co., Norfolk, Va., is considering early construction of new railway trans-shipment terminal at Deepwater, including wharves, docks, railway yards with shops and other facilities, warehouses, coal tipple and other structures. Electric power equipment will be installed for industrial service. A power house is planned. Entire project is reported to cost over $2,500,000. A. M. Traugott, Norfolk, is chief engineer.

Wis., Racine—Wisconsin Electric Power Co., 231 West Michigan St., Milwaukee, Wis., plans expansion in power substations in vicinity of Racine and Kenosha, with installation of equipment for increased capacity.

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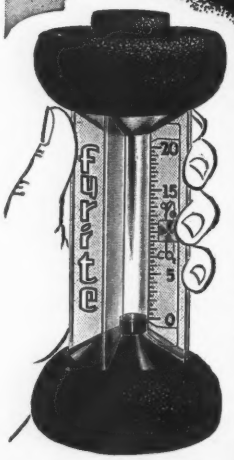

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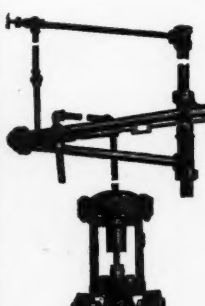

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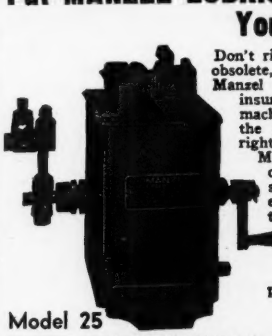

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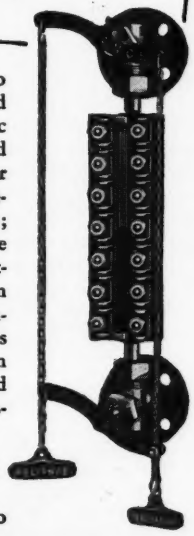

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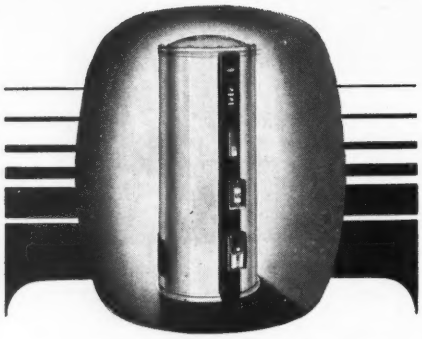

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JAMES W. PARKER has been elected vice-president and eral manager of the Detroit Edison Co.

Following his graduation from Cornell in 1908, he employed by the DeKalb (Ill.) Power & Light Co. and Vincennes (Ind.) Street Railway Co. as operating and plant engineer respectively. At the Detroit Edison C started as boiler room engineer of the old Delray plant. he was in charge of the design and construction of Co Creek, Maryville, Trenton Channel and Delray No. 3 of the company.

Prior to his election as vice-president and general ma of the Detroit utility, Mr. Parker was vice-president and engineer of the company. The general managership had held by Alfred C. Marshall, re-elected president, who had the position since 1923. In 1940 Mr. Marshall succeeded late Alex Dow as president.

In 1942 Mr. Parker served as president of the Ame Society of Mechanical Engineers and was active in orga tion work of the various branches of the society to pro the war effort. He is also past president of the Engine Society of Detroit.

Treasure Hunt Yields Rewards

QUANTITIES of more than 130 kinds of scarce critical terials urgently needed by war plants were made avai for immediate use as a result of the warehouse "tre hunt" recently completed by the Regional Redistribu Division of the War Production Board. The WPB York regional office recently issued a detailed report of "treasure hunt", which included personal visits by W staff men to 662 warehouses owned by 594 warehouse panies in the region.

Character of materials and the amounts resurre from storage covered a wide range. Completed tabulat showed 34 gal. of toluol and derivatives but 553,171 of fish liver oils. The search yielded only 100 lb. of mer but 4,270,500 lb. of burlap and new bags. The find of WPB men included pig and hog bristles, sunflower horse hair, metals ranging from steel to solder, a variety of important chemicals, and even goose and feathers.

Many of the materials found were so seriously neede war production that it was possible to conclude imme negotiations for transfer to plants that required them. Tr fer from warehouses to war plants were effected const during the progress of the survey.

The "treasure hunt" turned up for war production poses 3,618 items of machinery and machine tools. The was accomplished by 11 staff members of the Regional distribution Division, with the assistance of local W men in the upstate New York districts.

The survey covered 382 warehouses in the metropol New York area, 163 in northern New Jersey, and 11 the five upstate WPB districts, as follows: Utica dist 10; Rochester district, 20; Albany district, 25; Buffalo trict, 38; and Syracuse district, 24.

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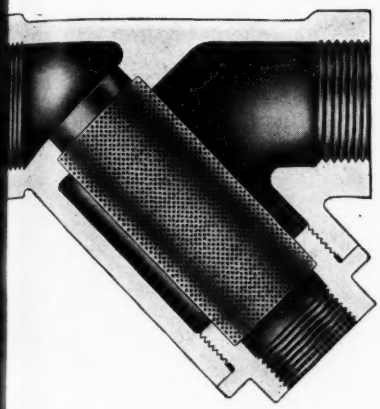

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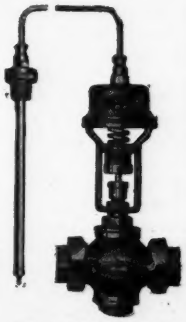

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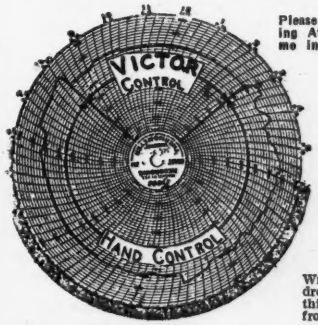

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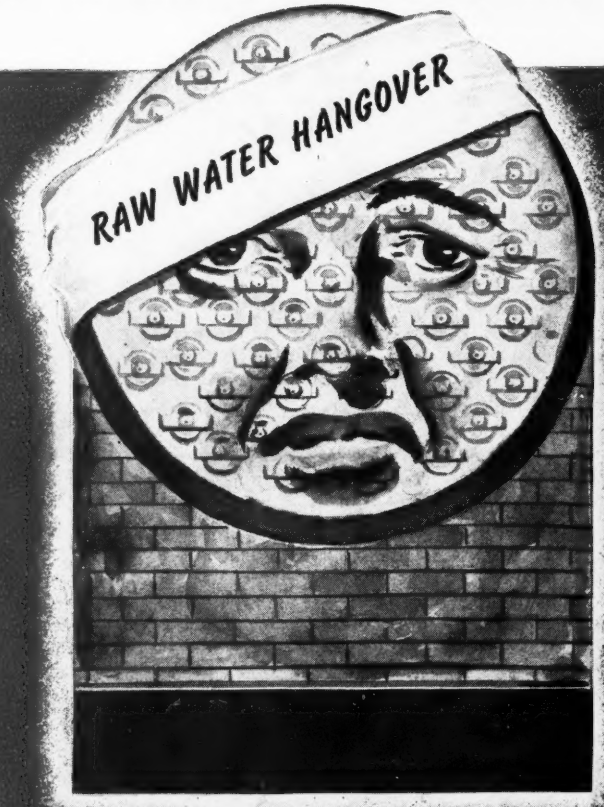

GOOD WATER keeps boilers on-the-line

BADLY needed tools of war must wait while scaled or corroded boilers are down for repairs. Impurities in the feedwater are to blame. Permutit* prevents these troubles by removing the impurities before the water enters the boilers. For instance, one plant reports: "We formerly had to re-tube boilers every three years, but since installing Permutit six years ago we haven't touched them as they're good as new."

Permutit's products include Zeo-Karb*, the zeolite that can be operated on the hydrogen or sodium cycle, hot lime soda softeners, deaerating heaters, silica removal and continuous blowoff equipment. A new process produces the practical equivalent of distilled water at a small fraction of the cost of distillation. Write us about *your* boilerfeed problem: The Permutit Company, Dept. A1, 330 West 42nd Street, New York, N. Y. In Canada: Permutit Company of Canada, Ltd. . . . Montreal . . . Toronto . . . Winnipeg . . . Calgary.

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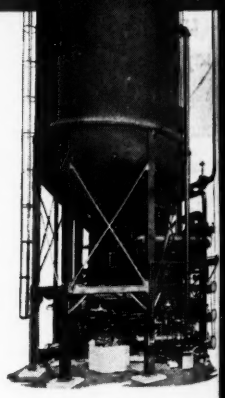

Permutit Deaerating Heater prev rosion. It's guaranteed to remove al (Winkler test) and free CO_2 from fe Utilizing exhaust or bled steam, it is d for pressures up to 100 pounds or capacities up to 1,400,000 pounds p

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